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MISSOURI BOTANICAL GARDEN BULLETIN

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MISSOURI BOTANICAL GARDEN BULLETIN

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Sixty-second Annual Report of the Director

Volume XXXIX January, 1951 Number 1

Cover: Winter View up Brush Creek at the Arboretum. Photograph by Dr. Henry N. Andrews.

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SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 50,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

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Vol. XXXIX JANUARY, 1951 No. 1

SIXTY-SECOND ANNUAL REPORT OF THE DIRECTOR

As is customary in the January issue of the BULLETIN, the Director of the Missouri Botanical Garden has the pleasure of presenting to the Board of Trustees the annual report on the chief events and activities at the Garden during the past year.

ARBORETUM ACTIVITIES

Help from St. Louis Garden Club.—One of the most heartening events of the last decade at the Arboretum was the sponsorship of its wild-flower trails. In the spring of 1950 the St. Louis Garden Club visited the Arboretum and ear-marked the profits from its 1950 Garden Pilgrimage for the development of these trails. Wild-flower gardening is an art little understood. Apparently the easiest type of gardening, actually it is by far the most difficult. In ordinary gardening the gardener selects the plants he wants and then takes care of them. In wild-flower gardening new introductions must largely fend for themselves. A successful wild-flower gardener must understand what plants will grow acceptably in association with each other and just what plants grow best in specific places.

In the last ten years a number of pilot plant operations have taught the staff of the Arboretum the beginnings of this art. In particular, since Mr. Louis Brenner was added to the staff, he and Mr. A. P. Beilmann have made various experiments in the construction of trails, in discouraging undesirable plants, in encouraging desirable ones already present, and in the introduction of new species. Experience has shown that comparatively narrow trails, slowly and painfully constructed, largely by hand labor, require minimum maintenance over a ten-year period; also that this type of trail does not bring in weeds, has minimum erosion, and increases rather than decreases the number of wild flowers. Although the work done this summer was expensive, costing about a dollar a running foot, it is cheap in terms of feet of trail per ten-year period. This year's contribution from the Garden Club of St. Louis made it possible to start the development of a comprehensive system of trails to the wild-flower areas. The glades, which are beautiful in early summer,

are adjacent to the Trail House. However, there has been no path within easy reach of the talus slopes along the river, which are spectacular in early spring, and it is then that the public is most interested in seeing native wild flowers. The Garden's first project therefore has been to construct as short trails as possible to the areas where the early wild flowers are at their best. This was done under Mr. Brenner's direction, utilizing techniques which he and Mr. Beilmann had previously worked out. A special upland limestone gravel was used instead of river gravel, and the path was constructed by digging to the bare rock wherever the soil was thin enough for this to be practicable. The new trails lead to some of the wooded cliffs along the river which are beautiful at all times of the year. Roughly, a quarter of a mile of graveled trail has been added to the previous system, and work is under way to provide direction signs, and labels for some of the more interesting wild flowers.

Visitors to the Arboretum.—The Arboretum has been visited and "used" by an ever-increasing number of organized groups. The Illinois Technical Forestry Association, the dendrology class of the School of Forestry at the University of Missouri, the Friends of the Land, several botany classes from Washington University, and the Eastern Missouri Beekeepers Association each spent a day at the Arboretum, during which they were taken on a conducted tour. More than twenty garden clubs from Illinois, St. Louis, St. Louis County, and outstate Missouri were also conducted through the grounds. A number of civic organizations, church groups, and boy and girl scout troops spent many hours at the Arboretum. Many groups braved the rain and cold to make the trip on the appointed day, and there were only two cancellations due to bad weather. The Garden feels complimented that the varied interests of such groups have been met by the activities of the Arboretum.

Improvements and Maintenance.—The completion, during the autumn, of a new road from the East Bridge to the Pinetum opens another section to the public and adds another mile to the road system. A total of 1,541 cubic yards of the Meramec River gravel, dug with the dragline, was used for hard-surfacing the road. About 25 hours a month were required to keep the main road system in shape through grading and rolling. Nearly 100 tons of gravel were needed to replace that worn or blown away during the year, in part by the 2,847 cars of visitors which drove over the roads. Garden trucks were each driven about 6,000 miles during the year in maintenance work.

Pot Hole Lake, begun last year, was finished this summer. Those portions of the watershed which were disturbed during the operation were graded and mulched. The half-million cubic feet of soil from the excavation were used

to fill a very deep ditch and to shape a badly eroded area near the quail and bee plots. This lake, having been dug with a dragline, has vertical sides, which should make it relatively free of algae and the usual pond weeds inhabiting warm shallow water. A small delta has been developed as a planting site for certain species of plants.

Cattle Reduce Mowing.—Largely from increase in the cattle herd, tractor mowing was reduced to 451 hours, about half the 1949 figure. The animals' somewhat selective mowing made it unnecessary to follow up with a machine. No better demonstration of the beneficial effect of cattle on blue-grass can be had than on Cherry Hill. Over 500 pounds of Arboretum blue-grass seed were harvested from that area in 1942, but in the succeeding seven years a vast array of woody weeds over-ran the grass. This year a herd of 15 cows and calves was placed on Cherry Hill during the winter and moved in May; later the area was sprayed with 2-4-D and mowed late in summer. Blue-grass has now come back to the extent that it should be suitable for combining for seed within another year. Portions of this area are being used in fertilizer tests. About 40 head of cattle will be rotated through four areas. It appears that only with the help of cattle can blue-grass be maintained over such vast acreages.

Farming operations have continued with only minor disappointments. The carrying capacity of the farm pastures appears to have been fully exploited with about 60 head of cattle on 262 acres, or about 4½ acres per cow for nine months. This is ten times the capacity of the same pastures just six years ago.

Silviculture.—During the year 140 trees were moved and planted, some of which were so large that they had to be lifted and reset by a crane. Water was hauled by tank truck to plants not well established after autumn and spring planting, but less irrigation was done than in many years. The addition of mulch and fertilizer to certain plants and groups was reflected in their improved growth. The tank truck was used to haul 27,000 gals. of sludge which was applied directly to older plantings in the Pinetum. The improvement following earlier applications is very noticeable.

The area served by the newly opened road is being planted with many trees and shrubs which, because of their exacting requirements, have not been successfully grown in other places. American Holly, Larch, Cypress, and perhaps Taxads in quantity, will be used, experimental plantings indicating that they will succeed in this region. The extension of such preferred deer foods may complicate the protection problem, but visitors can be expected to realize that festoons of barbed wire in holly do not involve a new horticultural technique.

Unforseen Disadvantage to Young Windbreak.—During the recent deer season hunters continually patrolled the normally deserted old Pacific road in the expectation of shooting a deer. Since the windbreak planted two years ago has not grown enough to obstruct the view into the Arboretum, it was necessary to see that no workmen were in that area at any time. Eventually, when the windbreak planting will have screened the area, this illegal hunting will cease, just as mounted patrol has reduced poaching along the river.

Orchid Growing at Arboretum.—More than 34,000 blossoms of hybrid Cattleyas and Cypripediums were grown at the Garden during the year, and numerous spray orchids and botanicals. There were 25,575 flowering plants potted, and 5,000 seedlings transplanted. To obtain more growing space, 2,200 plants have been suspended from the roof, 900 ft. of ½″ pipe, 2,200 ft. of ¼″ pipe, and 2,200 pot hangers being used for this purpose. When the greenhouses were built in 1925 the range included eight houses, 26′ x 100′, or 20,800 sq. ft. The present range includes sixteen houses aggregating 35,000 sq. ft. Another house 11′ x 100′ has been built between wings of the north range, using the new bar caps which seal the sash bars from weather and need of future painting. The laboratory, where Mr. Hans Gubler from Switzerland carried on his research work on orchids, was thoroughly equipped. Mr. Gubler has sown 110 flasks to hybrid Cattleyas and Cypripediums, and nearly 50 seed capsules from hybridization have matured.

Some of the outstanding seedlings originated from the English hybrids purchased in 1939 were registered with the American Orchid Society. These "St. Louis Hybrids" are: *Cattleya* "St. Louis"—white perianth, dark purple lip; *Laeliocattleya* "St. Louis"—large, dark mauve with darker lip (1,500 plants on hand); *L. C.* "Director George T. Moore"—large, mauve to claret, with darker lip; *L. C.* "Mobotgard", named after the Garden—dark mauve perianth and darker lip with golden throat; *L. C.* "Mimi Koehler", named in honor of the Veiled Prophet Queen, who carried them in her bouquet—golden perianth and dark purple lip.

Mr. Herbert L. Dillon of Long Island, N. Y., presented the Garden with 20 flasks of seedlings and 1,700 flowering plants. The first shipment was received August 26 of last year, and the second July 15, 1950.

Improvements in Orchid Ranges.—When the power plant at Gray Summit was built in 1926 two boilers were installed with a capacity of 24,000 sq. feet of radiation. One boiler would carry the load for the eight houses, at that time 10,470 sq. feet of radiation, and the other boiler would serve as a stand-by. With the building of eight new greenhouses the present load is 19,645 sq. ft. If a boiler fails while the temperature outside is 0°, a single

View taken from the pergola in the Italian Garden showing part of the crowd, the speakers, and the musicians, at the Henry Shaw Sesquicentennial Ceremony, July 23, 1950.

boiler could only bring the greenhouse temperature to 32°, which would mean that the entire orchid collection would be lost. It has thus been found advisable to install a stand-by boiler of 125-horse power, which will enable the proper temperature to be kept with any two of the three boilers. Since the two old boilers have been operating for the past eight years at full capacity, both were in need of repair work. The bases of both were cut away 24 inches and replaced with new material and the down-draft grates in No. 2 boiler were renewed and their brick foundations were replaced.

THE CITY GARDEN

The Henry Shaw Sesquicentennial Ceremony.—This ceremony, in commemoration of the 150th anniversary of the birth of Henry Shaw, sponsored by the 39th Street Business Association, took place on Sunday, July 23. Hon. Geo. H. Moore, judge of U. S. District Court and president of the Missouri Historical Society, and Hon. James M. Douglas, former Chief Justice of the Missouri Supreme Court and past president of the Missouri Historical Society, were the principal speakers. The ceremony, staged in the Italian Garden, was attended by various dignitaries and representatives of local civic, educational, and religious groups. The musical selections were by the St. Louis Post Office Junior Drum and Bugle Corps and Tyler Place Presbyterian Church quartet. Mr. William E. Buder acted as general chairman and master of ceremonies. The official program contained a brief biography of Henry Shaw and a description of the present status and aims of "Shaw's Garden".

Landscape Work.—Last spring an old group of various shrubs and several catalpas, bordering the walk from the floral display house to the Italian garden pergola, were removed. After compost and manure had been added to the soil a collection of holly, Austrian Pine, lilac, Leatherleaf Viburnum, Mentor Barberry, and Pfitzer and Andorra junipers were planted. *Vinca minor* was used as a ground cover along the foundation of the greenhouse, and the Bulgarian variety of English Ivy was planted in the larger bed west of the walk. Dogwood, redbud, flowering crab, and Bottle-Brush Buckeye *(Aesculus parviflora)* were added to the large shrub bed bordering the Citrus House. The beds along the west end of the Citrus House were planted with forsythia, lilac, and Blueleaf Honeysuckle, with a ground cover of English Ivy. Bottlebrush Buckeye, Pfitzer Juniper, and *Vinca minor* were placed along the west end of the Cactus House.

In 1917 many hawthorns were planted in the large beds bordering the rose garden. During the thirty-three years since then, those that became crowded or were broken by storms were removed and flowering crabapples planted in their place. With the addition of nine new varieties this year, the collection now contains thirty-two trees representing twelve varieties.

Five rose beds were remade in 1950, and for these and other beds in the rose garden 180 roses, representing 26 varieties, were purchased.

A great deal of soil, leaf mold, and manure was brought in to raise the level of the perennial beds in the Linnean Garden, and during the summer they were replanted. Many iris varieties were divided and replanted and 61 varieties of daylilies are now represented in this garden.

A major change was the transfer of the entire iris collection from the location south of the Old Residence to the two terraces in the Economic Garden. This move entailed the removal of an old barberry hedge and four beds of ornamental grasses in the Economic Garden, new soil and sand being brought in, and the entire area being plowed and disced. This new iris garden consists of 34 beds containing 750 varieties of iris. The iris were arranged according to their year of introduction, the oldest varieties being in the north beds and the latest varieties in the south ones.

A mass display of tulips occupied the beds of the main plaza in the spring, followed during the summer by a collection of bedding plants. Four white, and eight purple tree wisterias were planted in these beds which will, in a few years, make a striking display.

Through Mr. B. Y. Morrison, of the United States Department of Agriculture, 194 Glenn Dale hybrid azaleas were received. These plants are now in pots, but in the next few years they will be planted in the azalea collection west of the Mausoleum. They were sent to us to test their hardiness, and in the group there should be many which will prove satisfactory.

Waterlily Pools.—The three large pools in the main garden were planted to waterlilies on May 16 and 17. They did exceptionally well, flowering freely until the prolonged cold spell in early November. The Platter Lily, *Victoria Cruziana*, thrives in the St. Louis climate, and between 75 and 90 of the curious leaves fill the middle pool from August until frost. Some of the leaves attain a diameter of five feet. Probably nowhere else outside of the tropics, will such a fine display be seen. At least six quarts of Victoria seeds were gathered in 1950, enabling the Garden to ship seeds requested to botanical gardens in China, South Africa, Australia and Europe. This past year we have also secured seeds of the beautiful Australian lily, *Nymphaea gigantea*, and its white-flowered variety *alba*. One new hybrid day-blooming tropical lily, *Nymphaea* × "Jos. Cutak", was exhibited in the east pool. Several waterlilies of the pygmy type were shown in the pools for the first time, and pollination experiments were carried on with them during late summer. It is hoped that new dwarf types of lilies will be introduced in the next few years. The cat-tail pools in the knolls were redug and worked over. These cat-tails supply the dry fencing material used for chrysanthemum shows.

MAIN CONSERVATORIES AND EXOTIC RANGES.—

The Palm House.—During the first quarter of the year several plants in the Palm and Cycad Houses were removed in order to facilitate the replacement of the steampipes. This gave opportunity to work two loads of manure and leaf mold into the impoverished soil and replant the beds with fresh material. The tallest *Sabal mauriticeformis*, which had stood in the extreme southwest corner of the Palm House for the past 37 years, toppled over early in February but fortunately the only damage resulting was to the retaining wall which was repaired immediately. The fallen Fan Palm was cut in sections and studied on the spot by the botany seminar. Several clumps of the Dancing Girl Orchid, *Oncidium sphacelatum*, were divided and attached to two of the tallest Date Palms near the main entrance. The plants have made substantial growth during the year and several flower spikes have appeared. Another tall Phoenix Palm in the northeast bed supports *Billbergia thyrsoidea*, one of the showiest of all bromeliads. Scarlet "torches" grow from the bright green cups to brighten the massive trunks. A number of Philodendron species have been set out at the bases of large palms and numerous African Violets were propagated for planting in various sections of the house.

The Cycad House.—All three Silk Oaks *(Grevillea robusta)* in the Fern-Cycad House were cut down, along with two untidy Araucarias, to permit full view from either entrance of the very good stand of Cycads. *Podocarpus neriifolia*, the Wax Dammar of the Himalayas, was topped and the overhead Curtain Vine, *Cissus sicyoides* var. *Jacquinii*, had to be pruned heavily. The Rosary Vine, *Rhynchosia phaseoloides*, which produces small "beads" of black and red seed, had to be pruned. The five concrete posts were re-covered with bark to simulate tree trunks and the curious Staghorn Ferns, *Platycerium alcicorne* and *P. aethiopicum*, reset on them.

The Coffee-Banana House.—Coffee trees in the Coffee-Banana House flowered abundantly during the early part of the year, giving assurance of the best crops of berries for a long time. This, no doubt, was due to the application of manure and leaf mold. The berries began to ripen in December and will continue into the new year. The coffee trees with their glossy foliage and their white flowers followed by red berries, are very ornamental subjects. The vigorous white-flowered Oleander and several of the Sausage Trees *(Kigelia pinnata)* had to be cut back. A number of Hibiscus varieties and other miscellaneous material were planted out.

Other Tropical Houses.—The raised beds in the vestibule of the Economic House, after receiving a wheelbarrow of leaf mold each, were replanted with *Billbergia thyrsoidea* and *Aechmea Weilbachii.* These two bromeliads are quite colorful, and for several years now have replaced the grafted cacti

formerly exhibited there. Clumps of *Marica gracilis* and *Spironema fragrans* were used under the tall trees to make an effective ground cover in the Economic House. New economic plants were likewise added.

In the South African House three top-heavy spurges had to be removed. Fortunately all are well represented in the room. One of the spurges, *Euphorbia conspicua*, grown from seed sown in 1935, has reached a remarkable height of about 25 feet. Two other spurges, *Euphorbia lactea* and *E. ramipressa* raised from cuttings in 1940, were of smaller stature.

In the Cactus House a load of leaf mold was applied heavily in places occupied by various xerophytic bromels and night-blooming epiphyllums. One of the Stinging Nettles *(Cnidoscolus oligandrus)* and *Enterolobium cyclocarpum* were cut back to within five feet of the ground. The tallest variegated *Yucca aloifolia* snapped off and had to be trimmed to ground level. This plant suckers freely all along the stem. Plants of *Bromelia Balansae* were moved to a more favorable location near the tunnel door.

The annual fall cactus show of the Henry Shaw Cactus Society was held in early October. A collection consisting of Astrophytums, Echinocacti, Mammillarias and Cerei which had been donated to the Garden by Mr. George Neff's widow was featured. Mr. Edwin Lemp, of Kirkwood, presented a few choice cacti, among them a beautiful 4-foot Totem Pole, *Lophocereus Schottii monstrosus*. Mrs. John Balaski gave a big Barrel Cactus, *Ferocactus Wislizenii*. Potted Haworthias were divided to produce about 400 plants. In the lot are some very rare species, such as *Haworthia Jonesiae, H. mirabilis*, and *H. Maraisii*.

Flower Shows.—

The schedule of floral displays was the same as in past years. Poinsettias, buddleias and Garza Supreme chrysanthemums of the Christmas show were retained until mid-January, and then followed a small garden of primroses. Orchids were on view throughout February. Cyclamen and primroses followed the orchids, and a week later azaleas, cinerarias, genistas, and narcissi were added. The Easter display opened April 2 and was maintained through the month by the weekly addition of seasonable spring flowers. In May, astilbe, hydrangeas, and salpiglossis were the major flowers. The St. Louis Horticultural Society held its show in the Floral Display House, May 20–21. In early June, fuchsias and hydrangeas were shown, and from mid-June until early fall, fancy-leaved caladiums replaced the flowering plants. The Greater St. Louis Dahlia and Chrysanthemum Society held its fall show September 30 and October 1, followed by the cactus show of the Henry Shaw Cactus Society on October 7 and 8. The Veiled Prophet Queen's bouquet was displayed on October 11. The annual chrysanthemum show, which is always

the largest show of the year, continued from November 5 until December 3. Twelve new varieties of chrysanthemums were added to the collection this year, most of them of the spidery and thread-like types which are very popular. The search for better basket and cascade varieties of chrysanthemums is being continued. It is simple enough to grow a varied lot of chrysanthemums, but it is difficult to secure varieties which have thin, wiry stems and flowers with good keeping qualities. From a collection of seedlings a few promising varieties have been selected, but they still lack the graceful stem structure so essential for a good basket plant. The Christmas show of pink, red, and white poinsettias started December 10.

MAINTENANCE.—

During the year there were hauled 295 truck or trailer loads of brush, 104 loads of rubbish to an outside dump, and 322 loads of leaves (200 of these hauled by the city from surrounding streets). In the autumn the leaves are stockpiled near the old barn for partial decay, and the following August are shredded by the shredder take-off to the tractor for use in soil, Thirty-eight tractor loads of leaf mold were shredded this year, of which 18 loads were hauled to the soil shed for greenhouse use, 10 were used in the large conservatories, and 10 were applied as top dressing for shrubbery and flower beds.

The Garden was able to obtain 221 truck loads of topsoil from Vandeventer Avenue, which is being graded for a new post-office. Fifty loads of this were used in low areas north of the lake in the North American Tract, where blue-grass will be sown; and the rest was piled west of the nut orchard for future use. In changing beds in the Rose Garden, 21 loads of topsoil were taken from the North American Tract.

Power Plant Repairs.—Repair work accomplished during the summer included the following: renewing all blow-off piping located at rear of Nos. 1, 2 and 3 boilers; installing two new electric pumps in the north portion of the steam tunnel to take care of seepage water, and installing a new return pump and traps in the Experimental House valve chamber. The usual summer work of maintaining the heating plants at Gray Summit and the City Garden has been growing heavier each year. The repairs and replacements at Gray Summit will relieve the situation there, but the boiler equipment at the City Garden is being maintained on a day-to-day basis and it will have to be renewed in the near future.

The following construction work was done on the heating coils in the various houses: *Palm House*—In the southwest section, 1,680 ft. of 1¼-inch coil was replaced with new coil, and 560 ft. of old coil used; in the northwest section, 1,755 ft. of new 1¼-inch coil and 585 ft. old coil used;

supports in both sections raised and regraded. *Plant Curiosities House*—A total of 575 ft. new 1¼-inch coil and 275 ft. old used under west bench. *Pit Houses*—1,910 ft. old 1¼-inch coil used. *Fern House*—On west side 935 ft. new 1¼-inch coil and 470 ft. old used; coils raised out of trench; new supports constructed. *Aroid House*—Coils placed in trench (1,665 ft. new 1¼-inch and 1,665 ft. old coil used).

Funds are Needed for Major Greenhouse Repairs.—The main conservatories, completed in 1913, are now badly in need of repair. After the hailstorm of May 28, 1927, the entire roof area of the main conservatory was reconstructed. Such a major operation is beyond Garden handling and funds available for outside labor and materials have permitted only "stop-gap" repairs. During the year the steel girders supporting the south and north gables of the Palm House, which show considerable rust where they join the horizontal purlins, have been strengthened by welding 1,440 feet of 4 × 4 angle irons on both sides. Since the glass area, with the exception of top ventilators, is of U-bar construction, many of the wooden sash bars will have to be replaced when the range is reglazed in the near future.

Most of the top ventilators are above the walk and when not in repair are dangerous to visitors. Such danger has been eliminated for the present by removing 116 ventilators and replacing them with ones made in the carpenter shop during the winter. In the Citrus, Aroid, Economic and Cactus Houses, and three of the private growing-houses, vents and ventilating controls have been renovated, and 310 feet of ridge cap (on which vents are hinged) were replaced. During the summer, four growing-houses, with 4,000 square feet of roof area, were reglazed. This necessitated the renewal of many sash bars and replacement of 240 feet of galvanized angle iron purlins.

Concrete benches (2,320 sq. ft.) were built to replace the old slate benches in the four houses while repair of the roof was under way. The salvaged slate was used for a circular walk around the Rose Garden. The galvanized angle irons were used on the roof to replace the rusted-out purlins.

Miscellaneous Improvements and Repairs.—On Sundays and holidays, when the private entrances to the Garden are closed, visitors have entered through the grounds of the engineer's residence. To forestall this, 422 feet of cyclone fencing with service gate were erected around this house. Frequently, the Garden fencing on Alfred Avenue has been knocked down by automobiles in the early morning hours, and usually the Garden must repair the damaged fence. Fortunately, the 150 feet of fencing broken at Shenandoah Avenue during the summer was replaced through insurance adjustment.

During the winter the painter, assisted by other Garden labor, has decorated the rest-rooms and the four office rooms at the main gate, using 22 gallons of paint. (Unfortunately, a week after completion of the ladies' rest-room, the walls were thoroughly "decorated" with lipstick.) By the use of a new electric hand polisher all marble side walls were sanded and repolished. The interior and exterior of the Linnean House have been repainted. The exterior sash was caulked with a putty compound, 100 gallons being used. All woodwork received two coats of paint, 21 gals. of white, and the iron work received 5 gals. of rust-proof aluminum. The Rose Garden pergola was repainted, as were the window sash on the Victory statue building and the iron work in front of the windows of the Henry Shaw Mausoleum. Two coats of paint (60 gallons) were used on the interior woodwork and north gable of the Floral Display House, and one coat (6 gallons) of rust-proof aluminum on the iron work.

The north gable of the Palm House was reglazed because of the slipped glass of the upper section, and at the same time 21 gallons of white paint were used on the exterior. This necessitated erecting a scaffold 60 feet high. Two coats of white paint (20 gals.), and one of aluminum for iron work (4 gals.), were given the four growing-houses. Three thousand label stands, used for outside display and in the greenhouses, were cleaned of rust and repaired, using 2½ gals. of black paint. Although these stands are 20 years old, the annual cleaning and painting have kept them in excellent condition.

Other repairs or construction work consisted of the following: repairing and repainting the refrigerator which was built in 1926 to display the Veiled Prophet's Queen's bouquet; making eight new doors for the Linnean House; placing 20 feet of 4 × 4 channel girder above the service doors at the north entrance to the Floral Display House; removing 110 trees which were deemed dangerous to passing visitors; erection of a double garage at the rear of the engineer's residence; repainting the Director's residence; replacing the old galvanized gutter and coping on the northeast and east side of the Old Henry Shaw Residence; cleaning the woodwork and scenic ceiling in the auditorium of the Museum Building; and replacing 13 windows in the Old Residence, Museum, and Administration buildings.

Spray Programs.—During June, 4,800 gallons of lead arsenate were used in the power sprayer over the entire Garden to control an infestation of bagworms and tent caterpillars. Indoors, all the houses in the Main Conservatory were sprayed several times with Volck and nicotine, reducing insect infestation materially. A spraying program was also carried out in the Exotic Range.

Public Guide Service.—The guide service requested by schools, garden clubs, and convention groups was maintained, despite the fact that a trained man must be taken from his regular duties. About 50 hours of Mr. Cutak's time and lesser amounts from other personnel were used in conducting about 20 groups through the Garden.

RESEARCH AND INSTRUCTION

Missouri Plant Survey.—

In 1950 numerous new plant localities were recorded for various counties of the state, particularly in the northern and west-central portions. Plant surveys were made by Dr. Julian A. Steyermark in previously unsurveyed parts of Dekalb, Daviess, Gentry, Bollinger, New Madrid, Osage, Cole, Hickory, Randolph, Adair, Schuyler, Vernon, Nodaway, Andrew, Buchanan, Sullivan, Putnam, Audrain, Montgomery, Lewis, Knox, Mercer, Moniteau, Phelps, Shannon, St. Francois, and Ste. Genevieve counties. Forests with some virgin growth were discovered in Hickory, Bollinger, Schuyler, and Knox counties. A virgin prairie of considerable acreage was found in Phelps Co., 2 miles southwest of Elk Prairie and 10 miles southeast of Rolla. This is the only extensive natural prairie known to exist in the heart of the Missouri Ozarks. Thousands of Ladies' Tresses orchids *(Spiranthes cernua)*, downy gentians *(Gentiana puberula)*, Buchnera, and a great variety of prairie species were found there. A virgin forest along Crooked Creek in Bollinger Co. contained hundreds of the rare Adam-and-Eve orchid *(Aplectrum hyemale)*. The finding of the rare Squirrel Corn *(Dicentra canadensis)* in virgin forest in Hickory Co. set a new western limit for the species in Missouri.

One of the St. John Worts *(Hypericum canadense)*, previously unknown in Missouri, was found in Sullivan Co., northern Missouri. The Purple-fruited Mayapple *(Podophyllum peltatum* f. *Deamii)*, reported by Mrs. Mary C. Rodeman and previously known in a wild state only in Indiana, was tracked down in a woodland in Cole Co. with Mrs. Rodeman's assistance. A new form of *Helianthus mollis*, with short pale yellow ray-flowers and pale yellow disk-flowers, was discovered in Shelby Co.

The first occurrence in northern Missouri of the following species was recorded: Pinesap *(Monotropa Hypopitys)* and Late Coral-root orchid *(Corallorhiza odontorhiza)* from Schuyler Co.; Slender Ladies' Tresses orchid *(Spiranthes gracilis)* from Sullivan Co.; Ivy-leaved Duckweed *(Lemna trisulca)* and Yellow Water Crowfoot *(Ranunculus flabellaris)* from Mercer Co. Many new records for Indian Pipe *(Monotropa uniflora)* were added, especially from northern and central Missouri counties. In northern Missouri also, both the white and blue gentian *(Gentiana flavida* and *G. Andrewsii)* were seen in greater quantities than in the Ozarks. The rare Shooting Star

(Dodecatheon amethystinum), previously known to occur in Missouri in only one spot (Marion Co.), was discovered on limestone bluffs along the Missouri River in Cole and Osage counties. Dr. Fassett has verified the identification of this unusual species. On a float trip in late spring with Dr. Schery and a group of graduate students the Flowering Currant *(Ribes odoratum)* was found in Shannon Co. This record brings its distribution 100 miles east of its previous Missouri range, having been known in the White River region of Taney, Stone, and Barry counties. A number of first records for various counties was made of many species.

HORTICULTURE.—

Delphinium.—Due to the exceptionally cool spring and summer in 1950 the delphiniums did better than usual. Many of the crosses made to test the combinability of certain *D. elatum* lines used in back crosses with derivatives from the cross *D. elatum* × *D. cardinale* produced exceptionally fine plants. The seed from most lines was considerably above average both in quality and quantity. As a consequence, so many seedlings resulted from the sowings made in October for the 1951 cultures that the greenhouse space will be insufficient for growing them this spring. It is hoped that commercial growers in the area will assist by growing part of the seedlings in their greenhouses. During the past three years several of the growers, particularly John Tomasovic and John Lochner, have been very helpful in contributing from their stocks any plant that would be useful in horticultural research at the Garden. While Dr. Mehlquist was away this summer attending the International Botanical Congress in Stockholm, all of the seed, instead of being embryo-cultured, was stored in the refrigerator at 45° F. in air-tight glass vials after being dried at room temperature for five to ten days. Germination from the seed so treated was 75–90 per cent. On the other hand, all seed from the tetraploid lines which was stored at room temperature for three to four months germinated very poorly or not at all, but the diploids and hexaploids germinated reasonably well under the same conditions. The Delphinium project has had to be somewhat expanded in scope in order to facilitate the work of two graduate students, Miss Marilyn A. Gage and Mr. John H. Ayers, both of whom are studying the origin of certain garden Delphiniums.

Dianthus.—The research on carnations and related Dianthus species has been somewhat expanded with the help of a graduate student, Mr. Robert J. Gillespie, Jr., who is undertaking a genetical study of the available tetraploid types and their derivatives. During the past two years Dianthus seeds have been obtained from many sources anticipating space being made available in the Garden for testing as many species as possible for their garden value in this area.

Orchids.—Genetical and cytological studies of orchids are being continued. During the past year the chromosome numbers and cytological behavior of many species and hybrids not heretofore available have been investigated. Several commercial and private growers have been very he'pful in making available for experimental purposes plants otherwise not obtainable. A summary of the work to date was presented by Dr. Mehlquist at the International Botanical Congress in Stockholm this summer.

GENETICS.—

Dr. Edgar Anderson, Geneticist to the Garden, has continued his studies of variation in natural populations and in cultivated plants, particularly corn. The publication, a little over a year ago, of his book on "Introgressive Hybridization" summarizing the results of these studies and describing the new techniques on which they were based, has brought increasing demands for consultation and lectures. Some of these requests come from plant breeders who are interested in the application of these techniques to breeding problems; others are interested in the bearing of the results on general problems of evolution. A growing number are not biologists at all, but are archaeologists, historians, and geographers, who see the important bearing of these techniques on the early history of man.

In January, Dr. Anderson went to Oklahoma A. and M. College at Stillwater, giving two public lectures and consulting with a number of plant breeders. He then went on to the University of Oklahoma, Norman, where he gave one formal lecture and had a series of informal conferences. Later in the winter he made an eastern trip to Philadelphia and to North Carolina. In Philadelphia, under the joint auspices of the Academy of Sciences and the University of Pennsylvania, he gave three public lectures, one to a general taxonomic seminar, one to the archaeologists and one to the geneticists. In North Carolina he was the guest for several days of the Institute of Statistics at Raleigh and Chapel Hill, giving a series of lectures and conferences on the relation of hybridization to practical breeding problems and to general problems in evolution.

For the "Heterosis" conference held at Iowa State College, Ames, in June and July, Dr. Anderson gave a paper and demonstration in collaboration with his colleague and former student, Dr. William L. Brown of the Pioneer Hi-Bred Corn Company. The paper will appear as one chapter of a book which is being published covering the work of the conference.

In June, Dr. Anderson was one of the speakers at a symposium on evolution arranged for the meeting of the western section of the American Association for the Advancement of Science, which was held at Salt Lake City. In September, he organized and participated in a symposium on the role of

hybridization in evolution which was held in connection with the annual meeting of various biological societies at Columbus, Ohio. During the first half of the summer Dr. Anderson was a Visiting Professor at the University of Southern California. This allowed him to make extensive field studies of variability in the California flora, a flora much more complex than the eastern ones with which he has been primarily familiar.

A special fellowship grant from the Guggenheim Foundation has made it possible for Dr. Anderson, with the cooperation of the United Fruit Company, to operate a small experimental plot in the tropics on the grounds of the Escuela Agricola Pan-Americana in Honduras. Mr. George Freytag, who received his Master's degree from the Henry Shaw School of Botany in June, has gone to Honduras and is in charge of the plot, which is devoted to growing tropical strains of a number of plants of economic importance for observation and experiment.

Since the last war Dr. Anderson has had a series of part-time student assistants to fill the position formerly held by Mr. Leslie Hubricht. Beginning September 15 he has had the skillful services of a full-time scientific assistant, Miss Amy Gage, who received her Master's degree from the Henry Shaw School of Botany in June, 1950.

Dr. Gustav A. L. Mehlquist, Research Horticulturist to the Garden and Professor of Botany in the Henry Shaw School of Botany, has continued to devote time available for research to investigations on hybridization and cytogenetics of certain genera important in horticulture. In addition to the teaching in the Henry Shaw School of Botany which has centered around two courses, one in general horticulture and one on cytogenetics, he has taught the two courses in general horticulture and plant propagation offered by the Garden. One course is open only to students in the School of Occupational Therapy at Washington University Medical School; the other to any interested amateur, the number in this course being limited due to lack of greenhouse space.

Dr. Mehlquist represented the Missouri Botanical Garden at the Seventh International Botanical Congress in Stockholm, July 12–20. During the week prior to the Congress he attended the genetics and plant breeding excursions sponsored by the University of Lund. In addition, he visited leading botanical and horticultural institutions in Sweden and Denmark.

PALEOBOTANY.—

During the past year Dr. Henry N. Andrews and his students in paleobotany have made considerable progress in their studies of the American coal-ball plants. Numerous collections have been made in the southeastern Kansas and southern Illinois areas, and several new plants discovered. Per-

haps the most notable contribution of the year is the completion of the (Sergius H. Mamay and H. N. Andrews) study of a well-preserved fern (Botryopteris) from Illinois which has shed considerable light on the evolution of the leaf. The results of this study appeared in the December issue of the *Bulletin of the Torrey Botanical Club*. Well-preserved material of a closely related plant borrowed from Harvard University may add still more to our knowledge of the early ferns. Several other studies of the coal-ball plants are in various stages of completion. It is also significant to note that Dr. Sergius Mamay, who received his Ph.D. degree in June, is continuing these studies as a Guggenheim Fellow at the University of Cambridge during the present academic year.

Dr. Andrews represented Washington University at the International Botanical Congress which was held in Stockholm in July. These meetings were especially fruitful in making possible an exchange of ideas and information brought by numerous paleobatonists from many parts of the world. Before attending the Congress, Dr. Andrews spent three weeks in England and Scotland. The most notable phase of this side-trip was a week spent collecting fossil plants from the Jurassic beds of the Yorkshire coast. Partly as a result of very generous aid received from the British Museum (Natural History) this proved to be exceptionally profitable.

During several vacation periods Dr. Andrews has been able to continue with his compilation of a Generic Index of fossil plant names, under the auspices of the United States Geological Survey.

MYCOLOGY.—

Dr. Carroll W. Dodge, Mycologist to the Garden and Professor in the Henry Shaw School of Botany, has spent much of the time available for research in identifying miscellaneous collections sent in by correspondents from Canada, eastern United States, Louisiana, Texas, California, Colombia, Peru, Tierra del Fuego, and the Fiji Islands. Routine determinations of cultures of fungi, both human and plant pathogens, have been made for correspondents. Dr. Dodge was appointed an honorary member of the Facultad de Ciencias Medicas, Universidad Nacional de Chile, and gave a graduate course in medical mycology to 35 physicians and laboratory workers in Santiago for eight weeks. The usual courses of instruction at Washington University were given. Dr. Dodge served as vice-president of the section of Medical and Veterinary Mycopathology at the Fifth International Congress of Microbiology at Rio de Janeiro and was elected an honorary member of the Sociedad Chilena de Dermatosifilologia. He also collected some specimens in Chile, Uruguay, Brasil, Peru, and Costa Rica.

Mr. Richard G. Scharlott was appointed herbarium-assistant in mycology,

beginning October 1. The insertion of specimens of the A. de Crozals herbarium is nearly completed. This herbarium, purchased a few years ago, has assumed added importance as it contains cotypes from Dr. Maurice Bouly de Lesdain whose extensive herbarium was totally destroyed in the bombing of Dunkerque during the recent war.

SYSTEMATICS AND FLORISTICS.—

Dr. Robert E. Woodson, Jr., Curator of the Herbarium and Professor in the Henry Shaw School of Botany, has been particularly active in the reorganization and general care of the herbarium, progress of which is reported elsewhere. He also has had charge of three classes and the supervision of graduate students in the Henry Shaw School of Botany majoring in taxonomy of seed plants. His research activities have been concerned chiefly with the "Flora of Panama" and with various topics in the families Apocynaceae and Asclepiadaceae, particularly Aspidosperma, a large genus of timber trees in tropical America.

Dr. Robert W. Schery, Research Associate at the Garden and Assistant Professor in the Henry Shaw School of Botany, has, as in the past, divided his time between teaching at Washington University and various duties at the Garden. At the University he is in charge of the courses on elementary botany and economic botany, and occasionally assists with other courses. One of his chief non-teaching activities has been continued work on a forthcoming economic botany textbook. At the Garden, his research has been directed in large part towards tropical floristics, with issuance of two additional fascicles of the "Flora of Panama," of which he is part author and co-editor (with Dr. Woodson). Final months of the year have been devoted almost entirely to working over the Leguminosae in the Venezuelan collections of Dr. Steyermark. Local investigations concerning lawn care, shrub planting, etc. have from time to time engaged his attention. Dr. Schery has also continued in charge of assembling material for the Garden BULLETIN, and has been a frequent contributor to this publication. Miscellaneous other activities have involved occasional checking of specimens sent in by the public for identification, talks before local groups, field trips, and attendance at scientific conventions.

DEGREES AWARDED IN THE HENRY SHAW SCHOOL OF BOTANY.—

At the June, 1950, commencement, the degree of Doctor of Philosophy was conferred upon the following: Alfred G. Etter, A.B., Washington University (Ecology); Richard W. Holm, A.B. and M.A., Washington University (Taxonomy); Ko Ko Lay, B.S., University of Rangoon, and M.A., Washington University (Taxonomy); Sergius H. Mamay, B.S., University of

Akron, and M.A., Washington University (Paleobotany); Frank L. Mercer, B.S. and Ph.G., St. Louis College of Pharmacy and Allied Sciences, and M.S., University of Michigan (Physiology); Jonathan D. Sauer, A.B., University of California, and M.A., Washington University (Ethnobotany); and Carl B. Umanzio, Adj. Arts, Harvard University, and M.A., Boston University (Medical Mycology).

The degree of Master of Arts was conferred upon the following: Robert A. Dietz, B.S., The Principia (Ecology); George F. Freytag, A.B., University of Wyoming (Taxonomy); Marilyn A. Gage, B.S., Pennsylvania College for Women (Genetics); Hugh H. Iltis, B.S., University of Tennessee (Taxonomy); and Sidney D. Rodenberg, A.B., Washington University (Microbiology).

GRADUATES AND FELLOWS.—

The following graduate students and fellows were registered in the Henry Shaw School of Botany in 1950:

Graduate Assistants: Charles J. Felix, A.B., University of Tennessee (Paleobotany); Robert J. Gillespie, Jr., A.B., Washington University (Genetics); John M. Gillett, A.B., Queen's University, Ontario (Taxonomy); Hugh H. Iltis, B.S., University of Tennessee, and M.A., Washington University (Taxonomy); William B. James, A.B., University of Delaware (Physiology); Daniel O. McClary, B.S., Southeastern State Teachers' College, Oklahoma (Microbiology); George A. McCue, A.B., Washington University (Genetics); Robert B. Nevins, A.B., Washington University (Taxonomy); Sidney D. Rodenberg, A.B. and M.A., Washington University (Microbiology); Alice F. Tryon, B.S., Milwaukee State Teachers' College, and M.S., University of Wisconsin (Taxonomy); Masashi Yamada, A.B., Washington University (Microbiology); and Milton L. Zucker, A.B., Washington University (Physiology).

Henrietta Heermans Scholar: Reino O. Alava, A.B., Turku University, Finland (Genetics).

Special Research Assistant: Marilyn A. Gage, B.S., Pennsylvania College for Women, and M.A., Washington University (Genetics).

Special Research Grant from Pioneer Hi-Bred Corn Co.: Reino O. Alava, A.B., Turku University, Finland (Genetics); and Donald N. Duvick, B.S., University of Illinois (Genetics).

University Fellowship: David J. Rogers, B.S., University of Florida, and M.A., Washington University (Taxonomy).

Independent Students: John H. Ayers, A.B., Des Moines University, and M.A., University of Cincinnati (Plant Breeding); Robert A. Dietz, B.S., The Principia, and M.A., Washington University (Ecology); Thomas A. Graven,

A.B., Washington University (Horticulture); Marion T. Hall, B.S. and M.S., University of Oklahoma (Taxonomy-Genetics); Harrison A. Hoffman, B.S., McKendree College, and M.S., University of Illinois (Microbiology); and Yoneo Sagawa, A.B., Washington University.

PUBLISHED ARTICLES AND BOOKS.—

Allen, Paul H., Tropical Plant Collector: Pollination in *Coryanthes speciosa*. Amer. Orchid Soc. Bull. 19:528–536.

Anderson, Edgar, Geneticist: An Indian Garden at Santa Lucia, Guatemala. Ceiba 1:97–103; Methods of Popping Corn and their Historical Significance. Southwest Jour. Anthropol. 6:303–308; Naturalizing Flowers at Gray Summit. Parks & Recreation 33:345–349; A Rose for the Herb Garden. Mo. Bot. Gard. Bull. 38:97; Variation in Avocados at the Rodiles Plantation. Ceiba 1:50–55; review of Darlington and Mather's "The Elements of Genetics." Jour. N. Y. Bot. Gard. 51:145–146; review of I. I. Schmalhausen's "Factors of Evolution." Jour. N. Y. Bot. Gard. 51:283–284.

Andrews, Henry N., Paleobotanist: A Fossil Osmundaceous Tree-Fern from Brazil. Bull. Torr. Bot. Club 77:29–34; (with Sergius H. Mamay): A Contribution to Our Knowledge of the Anatomy of Botryopteris. *Ibid.* 462–494.

Beilmann, A. P., Manager of the Arboretum: The Bee in Botany. Mo. Bot. Gard. Bull. 38:155–158; The Bull Bay Magnolia in St. Louis. *Ibid.* 149–152; Count Calories for your Favorite Trees. Gard. & Gard. Chron. Dec. 1950; Crow Shooting. Mo. Bot. Gard. Bull. 38:167–170; Euonymus. *Ibid.* 109–112; Fruit Growing for the Home Orchard. *Ibid.* 132–137; Mountain Mint for Honey and Oil. Amer. Bee Jour. Nov. 1950; The Nut Trees. Mo. Bot. Gard. Bull. 38:145–148; Oak Wilt. *Ibid.* 115–116; Ornamental Shrubs of the Middle West. Arboretum Bull. (Univ. Wash. Arb. Found.) 13[1]:13–19; Native Missouri Trees and Shrubs. Amer. Nurseryman, Dec. 1, 1950.

Cutak, Ladislaus, in Charge of Succulents: Chlordane vs. Ants. Mo. Bot. Gard. Bull. 38:158–160; Growing and Enjoying Succulents. *Ibid.* 177–196; A New Foliage Plant from Panama (*Guzmania musaica*, var. *zebrina*). *Ibid.* 76–79; *Sedum lenophylloides*. Jour. Cactus & Succulent Soc. Amer. 22:124–126; Spine Chats—monthly feature in Jour. Cactus & Succulent Soc. Amer.

Dodge, Carroll W., Mycologist: Mycological Research and the Progress of Medicine. Ann. N. Y. Acad. Sci. 50:1213–1216.

Holm, Richard W., University Fellow: The American Species of *Sarcostemma* R. Br. (Asclepiadaceae). Ann. Mo. Bot. Gard. 37:477–559.

Kohl, Paul A., Floriculturist: Dress Up Your Garden with Ground Covers. Mo. Bot. Gard. Bull. 38:99–106; Pave it Yourself. House Beautiful's

Practical Gardener. p. 104; Urban Evergreens. Horticulture 28:222; Types and Uses of Ground Cover Plants. Modern Cemetery 60:125–126 (Reprinted from Garden BULLETIN).

Lay, Ko Ko, Burmese Government State Scholar: The American Species of *Triumfetta* L. Ann. Mo. Bot. Gard. 37:315–395.

Mamay, Sergius H., Washington University Fellow: Some American Carboniferous Fern Fructifications. Ann. Mo. Bot. Gard. 37:409–476; (with Henry N. Andrews): A Contribution to Our Knowledge of the Anatomy of Botryopteris. Bull. Torr. Bot. Club 77:462–494.

Mehlquist, G. A. L., Research Horticulturist: Inheritance of Color in the Carnation. Carnation Craft 12:6–11; A Mystery Solved—Why Chrysanthemums Bloom in the Autumn. Horticulture 28:301–315 (Reprinted from Garden BULLETIN); Orchids in the Home. Mo. Bot. Gard. Bull. 38:65–71; The Value of Organic Matter in Gardening. Amer. Peony Soc. Bull. 117:3–6 (Reprinted from Garden BULLETIN); Some Thoughts about Carnation Growing. Flor. Exch. 114^{16}:15, 56, 58–59; Why do Chrysanthemums Bloom in the Autumn. Gard. Club Amer. Bull. 38^{2}:22–25 (Reprinted from Garden BULLETIN).

Pring, George H., Superintendent of the Garden: The Bucket Orchid of the West Indies—*Coryanthes macrantha*. Amer. Orchid Soc. Bull. 19:550–551; Hardiness of *Magnolia grandiflora* in the St. Louis area. Mo. Bot. Gard. Bull. 38:160–165; A Hardy Japanese Bamboo (*Sasa palmata*). *Ibid*. 166; Here's a Lily Boat that Grows. Flower Grower 37:60–62; Nepenthes at the Garden. Mo. Bot. Gard. Bull. 38:27–35; Nymphaea "Joe Cutak". *Ibid*. 166–167; Waterlilies for Your Pool. Flower Grower 37:28–29, 64–66.

Sauer, Jonathan D., Henrietta Heermans Scholar: Pokeweed, an Old American Herb. Mo. Bot. Gard. Bull. 38:82–88; The Grain Amaranths: A Survey of Their History and Classification. Ann. Mo. Bot. Gard. 37:561–632.

Schery, Robert W., Research Associate: A la Maya. Mo. Bot. Gard. Bull. 38:116–117; Autumn Coloration in Missouri. *Ibid*. 139–143; The Horsechestnut as an Ornamental Tree. *Ibid*. 106–109; Ornamental Fruits for Autumn and Winter. *Ibid*. 119–132 (Reprinted in Gard. and Gard. Chron. Sept. 1950); Quintennial Report on Spring. *Ibid*. 73–76; A Second Look at an Unmowed Lawn. *Ibid*. 112–114; Miscellanea Taxonomica. I. Leguminosae. Ann. Mo. Bot. Gard. 37:398–403; Woodson's and Schery's "Flora of Panama", Part V, Fasc. 2. Leguminosae (in part). *Ibid*. 184–314; (with Robert E. Woodson, Jr.): edited "Flora of Panama," Part IV, Fasc. 1, and Part V, Fasc. 2. *Ibid*. 1–314.

Steyermark, Julian A., Honorary Research Associate: The Persimmon Tree. Garden Life 21:6–7 (Reprinted from Garden BULLETIN); Plant Names Found in Missouri Towns. Mo. Bot. Gard. Bull. 38:55–59; Scarlet Oak in

Missouri. *Ibid.* 143–145; Wild Orchids of Missouri. *Ibid.* 61–71; The Yellow in the Early Spring Landscape. *Ibid.* 71–73.

Tryon, Rolla M., Assistant Curator of the Herbarium: Charles Alfred Weatherby—Teacher and Counselor. Amer. Fern Jour. 40:9–11.

Van Schaack, George B., Honorary Curator of Grasses: Miscellanea Taxonomica. I. Gramineae. Ann. Mo. Bot. Gard. 37:397.

Woodson, Robert E., Jr., Curator of the Herbarium: Miscellanea Taxonomica. I. Liliaceae, Velloziaceae, Violaceae, Caricaceae, Loganiaceae, Apocynaceae, and Asclepiadaceae. Ann. Mo. Bot. Gard. 37:397–398, 403–408; The Vegetation of the Great Rift Valley (review of W. Robyn's "Flore des Spermatophytes du Parc National Albert"). Ecology 31:663–664; (with Robert W. Schery): edited "Flora of Panama," Part IV, Fasc. 1, and Part V, Fasc. 2. Ann. Mo. Bot. Gard. 37:1–314.

SCIENTIFIC AND POPULAR LECTURES.—

Dr. Edgar Anderson, Geneticist: Jan. 9, genetics seminar, Oklahoma A. & M. College, Stillwater, "The Significance of Introgression in Corn Belt Maize"; Jan. 10, at Oklahoma A. & M. College, sponsored by Phi Kappa Phi and Sigma Xi, and Jan. 11, at botanical seminar, University of Oklahoma, Norman, "Importance of Hybridization in the Flora of Oklahoma"; Feb. 9, (joint meeting with University of Pennsylvania and Lankenau Research Institute), "The Genetical Implications of Introgressions"; Dec. 29, in joint symposium of the Ecological Society of America and the botanical section of the American Association for the Advancement of Science, meetings of the A.A.A.S., in Cleveland, "The Evolution of Flora vs. the Evolution of Species."

Mr. August P. Beilmann, Manager of Arboretum: March 1, Ladue Garden Club, "Suitable Trees for the Home Grounds"; April 13, Washington, Mo., Optimists' Club, and South Side Conservation Federation, St. Louis, April 21, St. Louis Optimists' Club, April 24, Current River chapter of Ozark Protective League, and April 22, Conservation Federation, Columbia, Mo., "The Muskingum Conservancy District"; May 29, St. Clair, Mo., Lions Club, "The Arboretum"; June 29, short course for nurserymen, "Native Shrubs and Trees for Missouri Nurseries"; November 27, Washington, Mo., chapter Conservation Federation of Missouri, "The Conservancy District Program for the Meramec Basin."

Mr. Louis Brenner, Assistant Manager of the Arboretum: January 6, bio-ecology class, at Harris Teachers' College, "Bio-ecological Problems of the Plants of Our Native Flora"; February 7, St. Louis Beekeepers' Association, "Wild Flowers."

Mr. Ladislaus Cutak, in Charge of Succulents: Jan. 8, Henry Shaw Cactus Society, "Cactus Show Comments"; Jan. 20, Clayton Garden Club,

Group 5, and Oct. 5, The Garden Appreciation Club of Greater St. Louis, "House Plants"; Jan. 25, Talking Leaves Garden Club, Brentwood, March 17, Wisteria Garden Club, University City, April 13, University City Garden Club, May 11, Seekers' Club of University City, "Cacti and Succulents"; Feb. 16 St. Charles, Mo., Garden Club, "Succulents and How to Grow Them"; March 7, Alpha Phi Chapter of Beta Sigma Phi, "Four Seasons in the Garden," also April 18, before Millers' Mutual Fire Insurance Assn.; March 12, Henry Shaw Cactus Society, "Succulent Plants from the American Deserts"; March 14, Holy Name Society of Pope St. Pius the Fifth Church, "Canyon Treks and Desert Trails in Arizona"; April 12, Clayton Garden Club, Group 4, "Wild Cacti of the Southwest and Old Mexico"; April 27, Hawthorne Garden Club, Overland, "Mexico in Kodachrome", also June 16, before Millers' Mutual Fire Insurance Salesmen's Wives; May 14, Henry Shaw Cactus Society, "Grafting Cactus"; July 25, on Mrs. Herbert Ramel's "World Affairs" radio program, Station KFUO, discussion of Spice Plants, Tropical Fruits, Cacti and Succulents.

Mr. Paul A. Kohl, Floriculturist: Jan. 25, Rotary Club of Kirkwood, "The Missouri Botanical Garden"; Feb. 17, Greenbriar Hill Garden Club, "Roses"; March 24, Pine Tree Circle, Rosemary Garden Club, "Chrysanthemums"; April 19, Oakbrook Forest Men's Garden Club, "Chrysanthemums"; July 16, Franklin-Gasconade County Firefighters Assn., "The Missouri Botanical Garden"; Sept. 13, Woodbine Garden Club of Ferguson, "Roses."

Dr. Gustav A. L. Mehlquist, Research Horticulturist: Jan. 11, before the Ohio State Univ. Florists' Short Course, Columbus, "Some Thoughts about Carnation Growing"; Feb. 7, Sullivan Garden Club, Sullivan, Mo., "Plants Suitable for Gardens of Missouri"; Feb. 12, Henry Shaw Cactus Society, "The Soil and Its Relation to Plant Growth"; March 7, American Carnation Society Convention, Milwaukee, "What Carnation Breeders Can Do to Combat the Disease Problems of Carnations"; March 16, Kirkwood Chapter of DeMolay, "Orchids and Their Propagation and Culture"; April 14, Greater St. Louis Dahlia and Chrysanthemum Society, "Chrysanthemums, Their Behavior and Culture"; April 20, St. Charles, Mo., Garden Club, "Lilies and Their Culture in the St. Louis Area"; May 5, St. Louis Horticultural Society, "Soils and Fertilizers"; at International Botanical Congress, Stockholm, Sweden, July 14, "Polyploidy in Certain Genera of Orchids," and July 19, "Hybridization in Delphinium"; Oct. 11, Federated Garden Clubs of Missouri Convention, "New Trends in Horticulture"; Oct. 25, Ladies' Auxiliary of the Irish Divine Science Church, "Pot Plants and Their Culture"; Oct. 8, Greater St. Louis Flower Growers' School, "Gardens and Horticulture in Scandinavia."

Mr. George H. Pring, Superintendent: Jan. 5, Optimists' Club of Kirk-

wood, "Mr. Shaw's Garden"; Feb. 3, Chicago Horticultural Society, Chicago, Ill., Feb. 7, Mothers' Club of Beaumont High School, and Feb. 15, St. Louis League for the Hard of Hearing, "Four Seasons at the Missouri Botanical Garden"; Feb. 17, Clayton Garden Club No. 2, March 2, South Side Twelve Club, March 13, Alpha Chi Sigma, "Mr. Shaw's Garden"; March 14, Congregational Church group of Webster Groves, and March 31, Webster Groves Garden Club Group IV, "Visiting English Gardens"; April 12, Women's Guild of the Zion Evangelical and Reformed Church, "Four Seasons at the Missouri Botanical Garden"; at Los Angeles, Calif., April 18, joint assembly of American Orchid Society, the Orchid Society of Southern California, and the Cymbidium Society, and at Oakland, Calif., April 25, joint assembly of American Orchid Society and the Orchid Society of California, "Orchids Past and Present"; May 12, Woerner School Parents' Association, "Mr. Shaw's Garden"; June 12, Men's Garden Club of Webster Groves, "Originating Tropical Water-lilies"; June 14, First Presbyterian Church, Alton, Ill., "Visiting English Gardens"; June 22, Margaret Krueger Conservation Club, "Mr. Shaw's Garden"; Sept. 11, Alpha Xi Delta, "Orchids"; Oct. 5, Paducah Garden Club, Paducah, Ky., "Four Seasons at the Missouri Botanical Garden"; Oct. 10, College Club of St. Louis, "Orchids"; Oct. 17, Maplewood Rotary Club, "How Flowers are Pollinated"; Oct. 26, Collinsville Garden Club, "Four Seasons at the Missouri Botanical Garden"; Nov. 2, Shrewsbury Garden Club, "What Constitutes a Good Gardener"; Nov. 8, Kirkwood Methodist Men's Club, "Mr. Shaw's Garden"; Nov. 16, Goodfellowship Club of the Independent Protestant Church, "Four Seasons at the Missouri Botanical Garden."

Dr. Robert W. Schery, Research Associate: Feb. 13, Monday Club of Webster Groves, "Missouri Hills and Streams"; Feb. 27, Corona Park Improvement Association, "Lawns and Shrubs for the Small Home"; April 5, University of Minnesota botany seminar, Minneapolis, "Secondary Rubber Production in the American Tropics"; Oct. 19, Webster Groves Garden Club, "Native Beauty of the Ozarks"; Oct. 21, Greenbriar Garden Club of Kirkwood, "Lawn Establishment and Care"; Dec. 6, P.E.O., "The Missouri Scene."

COLLECTIONS AND PUBLICATIONS

THE HERBARIUM.—

During the past year 25,363 sheets were mounted and inserted in the herbarium, bringing the estimated total to 1,601,285 specimens. Within the same period a total of 13,564 herbarium specimens was accessioned for future mounting and insertion, of which 9,651 were received in exchange from other institutions, 2,999 as gifts, and 914 as the result of field explorations in Mexico and Panama by parties from the Missouri Botanical Garden. Breaking down the total in another way, it may be noted that

of the 13,564 specimens accessioned, 1,469 are from the United States or Canada, 4,140 from tropical America, 1,871 from Asia or Oceania, 5,058 from Africa, and 1,026 "miscellaneous." Although all of these collections are of some definite and peculiar interest, perhaps most noteworthy may be considered the acquisition of Set IV both of Rodin's plants of South Africa and of Forrest's plants of Tibet and adjacent China and Burma.

The matter of exchanges and loans is a good indication of the vitality of a museum, and it is of great satisfaction to our herbarium staff to recall that during the year 1949 the total of 9,651 specimens accessioned as "exchanges" came to us from nine domestic and sixteen foreign herbaria (5,437 specimens and 4,214 specimens respectively). During the same period the Garden sent out 24,853 specimens as exchanges to ten domestic and twenty-two foreign herbaria (12,761 and 12,092 specimens respectively). The discrepancy of specimens received and specimens sent out is explained by our sudden good fortune in being able to "pay off" several very oppressive "exchange debts" incurred during many years past.

During the year the Garden herbarium received requests for the loan of 6,765 sheets from thirteen domestic and seven foreign herbaria. In the same period the Garden borrowed for the use of its staff and students 1,998 specimens from five domestic and ten foreign herbaria. This discrepancy is tribute to the value of our collections and to the esteem in which they are held by our sister museums.

Continued progress has been made in alleviating the many unfortunate conditions accumulated through many past years as the result of wholly insufficient staff and budget. This progress, however, is in directions quite unfamiliar to a museum which long has enjoyed adequate support: the complete re-organization of large sections of the herbarium previously in disorder, the extraction of worthless or excess specimens to create room for more valuable collections, scheming for means to reduce heavy "exchange debts" which place us at serious disadvantage in the accession of desirable material, and the establishment of new inter-museum contacts, particularly abroad. Most heartening progress has been made by the herbarium staff in all these respects, working during holidays and nights as well as during "work hours"—but it has been at the expense of the more technical functions for which they were trained.

One of the most serious handicaps under which our herbarium has operated in the past has been inadequate help in the mounting of specimens, since the Garden employs only one "mounter" who has had impaired health for several years. During the past year assistance in the mounting of specimens has been had through the out-patient department of the St. Louis Occupational Therapy Workshop. The results have been most satisfactory,

mutually, and it is hoped to continue the program for the coming year.

At the present writing there is not a single adequate herbarium collection of African plants in America. This disturbing fact was demonstrated very pointedly, in recent months, when wide publicity was given to "cortisone", a new drug found in the African genus *Strophanthus*, and reported to be the most promising palliative or cure for arthritis. Botanical gardens in this country immediately were requested by medical research laboratories to furnish information and specimens of this "common" African plant, which thereupon was found to be scarcely represented at all in our collections! Information concerning the kinds of *Strophanthus* and where they are found was almost completely lacking in this country and had to be gotten from Europe before an intelligently prepared expedition could be sent to the Dark Continent to obtain it for experimentation.

The illustration should be sufficient to emphasize the need, in fact the duty, of our museums to maintain collections of plants from the entire world for study and for reference: not merely plants of Missouri nor of the United States, not merely pretty plants nor plants of presently known value, but *all kinds* of plants from *everywhere*, in case of future emergency.

When the Missouri Botanical Garden was founded in 1889, the two foundation stones of its herbarium were the personal collections of Engelmann and of Bernhardi, and amongst them was a large series of African plants which must have been really impressive at that time. But this collection has been augmented only casually since then. It is the intention of our present herbarium administration to build up this collection as rapidly and as completely as possible, so that there will be at least one fairly comprehensive herbarium of African plants in America.

The very satisfactory progress which has been made in this direction is testified by the accession of 5,058 specimens of African plants during the past year. Of these, perhaps half were of species or genera, or even of families, entirely new to our collections. These specimens have been obtained by inaugurating new exchanges with the great colonial herbaria of western Europe and with several of the herbaria of Africa itself. Many have been received outright as gifts. A promising contact has been made with the agriculture department of Cuttington College, in Liberia, by means of which excellently prepared specimens of plants are being sent to St. Louis for identification, for the benefit of a duplicate collection being maintained at the College.

Probably for many years to come the major research of the herbarium staff will have to be confined to American plants. Dr. J. M. Greenman, curator emeritus, has continued his studies of tropical American Senecios. Dr. R. E. Woodson, Jr., curator, has completed a monograph of *Aspido-*

sperma, an important genus of tropical American timber trees. Dr. R. M. Tryon has continued his studies of *Selaginella* and *Pellaea*. Dr. G. B. van Schaack, honorary curator of Grasses, has devoted most of his time to extensive re-organization of the Garden's collection of Gramineae, but also has continued his special studies of the Hordeae and the Andropogoneae. Dr. R. W. Schery, research associate, has continued his preparation of the account of Leguminosae for the "Flora of Panama" which he compiles with Dr. Woodson and numerous American and European collaborators. Postgraduate research has included special studies by the following students of the Henry Shaw School of Botany of Washington University: George F. Freytag *(Guazuma)*, John M. Gillet *(Gentiana)*, Richard W. Holm *(Sarcostemma)*, Hugh H. Iltis *(Cleome)*, Ko Ko Lay *(Triumfetta)*, Robert B. Nevins *(Schrankia)*, David J. Rogers *(Stillingia)*, Alice F. (Mrs. R. M.) Tryon *(Sellaginella)*. Of these, Mr. Freytag and Drs. Holm and Ko Ko Lay completed their studies, and assumed professional duties at the Escuela Agricola Pan-Americana (Tegucigalpa, Honduras), Stanford University, and the University of Rangoon (Burma), respectively.

THE LIBRARY.—

The usual routine of library work—checking book-catalogues, ordering, cataloguing, reference work, etc.—was maintained during 1950. Little other work was able to be accomplished, partly due to the fact that two of the three library assistants have had to alternate as telephone operator since September. However, the shifting of the books in the basement was completed during the year, and the seed catalogues have been placed in boxes labelled according to the seed or nursery firm. The Garden has one of the best collections of such publications in the country, which have been found useful to those studying the history of horticultural varieties. Most of the routine library work is done by Miss Edna Mepham.

Garden Publications.—The work of getting out the Garden publications is done by the librarian, who prepares and checks the manuscripts for the printer, does the proofreading, compiles the indexes, and tends to the secretarial work relative to the publications. This has been an unusually active year at the Garden as far as printing is concerned, for in addition to the ANNALS and the BULLETIN a new set of eight post-cards showing views of the Garden was printed in Switzerland. They are the most beautiful of any that the Garden has ever put out and will be on sale at the main gate after the first of the year. Another "Tour of the Garden" was also issued during the year, for the use of Garden visitors. The cash receipts during the year for all the Garden publications—post-cards, Tours, BULLETINS, ANNALS, "Flora of Missouri", etc. were $6,432.66.

Volume XXXVII of the quarterly ANNALS, which was issued during the year, consisted of 660 pages, 14 plates and 144 text-figures, being about 1½ times as extensive as customary. Two of the numbers were installments of Woodson's and Schery's "Flora of Panama", No. 1 being "The Piperaceae of Panama," by T. G. Yuncker, and No. 2, beginning "The Leguminosae of Panama," by Robert W. Schery. Numbers 3 and 4 contained four doctoral dissertations, and established a record for long-distance editing, since one author, Ko Ko Lay, was in Burma, Sergius Mamay in England, Richard Holm in California, and Jonathan Sauer in Wisconsin. A new series was started with this volume of the ANNALS—"Miscellanea Taxonomica", consisting of descriptions of new plant entities by the taxonomists of the Garden.

Vol. XXXVIII of the BULLETIN, the monthly publication, contained 199 pages and numerous illustrations. Some of the noteworthy bulletins were the special number on "Herbs" by the local members of the American Herb Society, issued when the national Society met in St. Louis during May; the March number which constituted the essays on "Henry Shaw" read at the graduation program of the John Scullin School celebrating the sesquicentennial of Shaw's birth; and the December number on "Growing and Enjoying Succulents" by Ladislaus Cutak. A large number of the BULLETINS are sent to Friends of the Garden.

About 500 journals are received from other scientific institutions in exchange for the ANNALS. The foreign shipments are sent through the Smithsonian Institution in Washington, but as of 1949 none are now being sent by them to China, Russia, or the eastern zones in Germany. The bookkeeping and all the work connected with sending out the Garden publications is in charge of one of the library assistants, Miss Ida M. Kohl.

Library Accessions.—Aside from current publications, most of the wanted books and periodicals are obtained through foreign book-catalogues, but the few that have been listed during the last year were either prohibitive in price or else sold before our order arrived. However, we have been able to obtain missing parts and even entire volumes by photostatic reproduction. Two of the most important of these were: "Memoires sur la Familles des Fougères", by A. L. A. Feé; and the missing 76 pages of Wallich's "Catalogue of East Indian Plants," this work being one of the seven copies of a noteworthy manuscript list made available to us in 1949 through Drs. Killip and Walker, of the Smithsonian Institution. Dr. Fred G. Meyer, a member of the Garden staff, now in England, has been instrumental in having reproductions made of publications in the British Museum.

Some of the current books purchased during the year were the following: Brooke, J., The wild orchids of Britain; Corner, E. J. H., A monograph of Clavaria and allied genera; Curtis, C. H., Orchids—their description and

cultivation; Gäumann, E., Principles of plant infection; Maerz and Paul, A dictionary of color; Matsumura, J., Index plantarum japonicarum, vols. I & II; Metcalfe & Chalk, Anatomy of the Dicotyledons, vols. I & II; Taylor, W. R., Plants of Bikini and other northern Marshall Islands; Tischler, G., Die Chromosomenzahlen der Gefässpflanzen Mitteleuropas; Viennot-Bourgin, G., Les Champignons parasites des plantes cultivées, Tomes I & II.

Among the gifts received were a collection of sixteen 19th century works on pharmacognosy and medicinal plants, from Mr. Trifon von Schrenk; Velez' "Plantas Indeseables en los Cultivos Tropical," and Gardner's "West Australian Wild Flowers," the gift of Dr. Edgar Anderson; Guinea López' "Recursos del Medio Biologico Vizcaya y su Paisaje Vegetal," from Dr. Robert E. Woodson, Jr.; and six regional floras from the collection of the late C. A. Weatherby, donated by Dr. Rolla M. Tryon.

Library and Herbarium Visitors.—In addition to the graduate students and staff of the Shaw School of Botany, the classes in pharmacognosy of the St. Louis College of Pharmacy have made extensive use of the Garden library during the year. The graduate students from St. Louis University have also been frequent users. Among the out-of-town investigators who spent days or weeks in the library and herbarium were the following: Dr. Emilio Willems, of Sao Paulo, Brazil; Mr. John O. Taylor, of the Botanical Gardens, Christchurch, New Zealand; Mr. Maung Tin, Economic Botanist of the Government of Burma, Mandalay, Burma; Mr. Paul H. Allen, of Golfito, Costa Rica; Dr. Charles B. Heiser, of the University of Indiana, with a group of his graduate students in botany; Mr. G. Edward Nicholson, of the Food Supply Division, Institute of Inter-American Affairs, Lima, Peru; Dr. Russell J. Seibert, Director of the Los Angeles State and County Arboretum, Arcadia, California; Dr. Lloyd N. Shinners and Dr. Eula Whitehouse, of Southern Methodist University, Dallas, Texas; Dr. A. J. Sharp, of the University of Tennessee; Dr. B. M. Duggar, of the Lederle Laboratories, Pearl River, N. Y.; Dr. Alberto Soriano, of Buenos Aires, Guggenheim Fellow, California Institute of Technology, Pasadena; Mr. Howard A. Crum, graduate student, University of Michigan, Ann Arbor; Mr. Donald L. MacNeal, of the Philadelphia Academy of Natural Sciences.

The Garden library also loans books on the inter-library loan plan, 178 such loans having been made to 51 institutions during the year.

Statistical Information.—There have been donated to the library or received in exchange for our publications during the year 512 books valued at $1,611.15, and 1,144 pamphlets valued at $344.43. The purchases consisted of 291 books at a cost of $1,663.03, and 34 pamphlets and parts of volumes at a cost of $26.96. The library now contains 59,985 books and 104,250

pamphlets, and 339 manuscripts. The number of index cards now totals 1,130,289, of which 5,406 were added during the year, 580 having been written by Garden employees and 4,826 purchased at a cost of $131.20. There were 288 books bound or repaired during the year.

ANNUAL BEQUESTS

The Gardeners' Banquet Fund was used to provide turkeys for the employees at Christmas.

ATTENDANCE FOR 1950

(Not including visitors to Arboretum)

	Week-days	*Sundays*
January	1,942	4,523
February	3,961	6,197
March	3,852	4,252
April	10,282	9,913
May	12,464	9,463
June	13,960	8,243
July	18,502	10,639
August	14,667	9,558
September	11,407	7,532
October	12,983	16,292
November	6,992	11,237
December	3,080	2,427
	114,092	100,276
		114,092
Total		214,368

Respectfully submitted,

GEORGE T. MOORE, *Director.*

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MISSOURI BOTANICAL GARDEN BULLETIN

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Cover: Main Gate House at the Arboretum. Photograph by Dr. Henry N. Andrews.

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Missouri Botanical Garden Bulletin

Vol. XXXIX FEBRUARY, 1951 No. 2

PLANT SURVEY OF MISSOURI

JULIAN A. STEYERMARK

Since earliest times man has attempted to describe plants and has given names to most of them. Estimates of the number of named species of flowering plants vary from 250,000 to 500,000, yet many botanists believe that only one-half to two-thirds of all species have been described and catalogued, and that many thousands, principally from tropical and subtropical regions, remain to be discovered. Essential information about a plant, besides naming, consists of the place where it grows, whether it is rare or common, and whether it serves any useful purpose. In the early days of the United States, many wild plants were known in folk-lore or medicine, but as the people gradually drifted to cities, they became less concerned with plants and much of this plant lore disappeared.

Geographical Range of Plants.—Each plant possesses a definite geographical range which is commonly correlated with climatic (rainfall, temperature, altitude) and soil conditions, geographic barriers (mountains, deserts, valleys, rivers) and the geological history of the area (previous continental submergence, uplifts, mountain-making, glacial advances and retreats). Plant geography shows the limits of a species range, and whether the species is rare or common. The quest for quinine and natural rubber during the last war, to mention two well-known examples, was aided considerably by the information already on hand as to the geographical distribution of the various species of Cinchona and Hevea.

Necessity of Herbarium Records.—In order to obtain a complete story of the geographical distribution of plants, detailed exploration, collecting, and recording become necessary. Without the dried and pressed specimen bearing information as to date of collection, habitat and locality, the science of plant geography could not progress. The herbaria (collections of pressed plants) in the great botanical institutions throughout the world serve as the storehouse for such information. In this country each of the forty-eight states must be explored botanically, county by county, before a thorough

compendium of geographical data is at hand. California, Florida, Texas, and the states in which the Great Smoky and Blue Ridge Mountains are located, have a more diverse and more complex flora to work out than such states as Kansas or Iowa.

Missouri a Meeting Ground for Species.—Missouri is the meeting ground for various plant species. Some southern species, such as the Corkwood *(Leitneria floridana)*, reach their northernmost station in Missouri. Others, such as the Hay-scented Fern *(Dennstaedtia punctilobula)*, have not traveled any farther westward than eastern Missouri. One of the southern limits of

Yucca arkansana, a rare species confined to a few counties in extreme southern Missouri.

a predominantly northern species, the Harebell *(Campanula rotundifolia)*, is in Missouri. Among the plants of western affinity, *Andrachne phyllanthoides*, *Acacia angustissima* var. *hirta*, and Yellow-rayed Cone-Flower *(Echinacea paradoxa)* are not known any farther eastward than Missouri.

Botanical Exploration in Missouri.—One might suppose that the geographical records for Missouri plants are more or less complete. The truth is, however, that much remains to be learned. The early botanical explorers in Missouri (Bradbury, Schoolcraft, Shumard, Swallow, and Broadhead) made only random and scattered collections. A few counties have been assidu-

ously explored: St. Louis Co., by Engelmann, Eggert, Letterman, and Kellogg; Boone Co., by Daniels, Rickett and Drouet; Jackson Co., by Mackenzie and Bush; Greene Co., by Standley, Blankenship, and Shepard; and Jasper Co., by Palmer. Trelease worked sections of the Ozark region, but in his day travel was difficult and time-consuming. Bush made his interesting discoveries in the loess mounds of northwestern Missouri, the swamp section of southeastern Missouri, and the "bald knob" flora of the southwestern section, etc. Palmer collected in many areas in the state and added a wealth of new data. Despite this range of activity, much of the information obtained

Thalia dealbata, known in Missouri only from the region of Poplar Bluff for over half a century, but recently found in two additional counties. This species reaches its northern limits in Missouri.

was fragmentary for several reasons: first, most of the exploration had been concentrated south of the Missouri River; second, collectors had often visited favorite areas over and over; third, travel was limited by poor roads or by slow transportation; fourth, data as to exact locality were mostly too generalized and often missing, so that it was usually impossible to rediscover a particular spot where a certain plant had been found.

In 1933, Mr. Palmer and I began a systematic survey of the state, county by county. This resulted in 1935 in the publication of a catalogue of the flowering plants of Missouri which included the known geographical range of each species. Since that time, I have continued the exploration.

Progress of Plant Geography in Missouri.—Some idea of the progress that has been made in our knowledge of the geographical ranges of native Missouri

Edmonson Pond, south of Lowwassie, Shannon Co.—an upland sink-hole pond, habitat of rare and unusual species.

Tupelo Gum *(Nyssa aquatica)* in an upland sink-hole pond, northwest of Bennett, Ripley Co.; elsewhere known in the state only from the southeastern lowland section.

plants may be shown by the following examples: (1) One of the Bur-reeds *(Sparganium eurycarpum)*, known from only four counties in 1935, has, through exploration in out-of-the-way localities, been found in eight additional counties. (2) The Ginseng *(Panax quinquefolium)* was known from only ten counties scattered in the state. Today it has been collected through no less than 43 counties. (3) The Cow Parsnip *(Heracleum maximum*, formerly known as *H. lanatum)*, which had been found in only three counties up to 1935, has been collected in ten. (4) In the latter half of the nineteenth century, Letterman first discovered the False Hellebore *(Veratrum Woodii)*

in Missouri. This locality, around Allenton in St. Louis County, remained its only known Missouri station for many years. However, by 1935 it had been found in 29 counties, and as a result of more detailed exploration, this number has been extended to 54, being found throughout eastern Missouri and most of the Ozark region.

Difficulties of Plant Exploration in Missouri.—There are now many obstacles in the collector's path which did not exist twenty-five or fifty years ago. One is the great increase in population with its attendant real-estate and lumber booms. Great sections have been cleared, burnt, or cut over for agriculture, or real-estate improvements. Saw mills have become so widespread in Missouri that very little virgin timber is left. Many kinds of natural and unusual habitats, such as swampy meadows, are being destroyed

Nymphaea odorata (Sweet-scented Water-lily) in slough northwest of Qulin, Butler Co.

with development of more intensive agriculture and increase in human population. Each year soil is being eroded at an increasingly dangerous rate.

Another danger which threatens our native flora is the erection of the big dams. Miles of bottomland, river banks, wooded slopes, rocky bluffs, and innumerable unique plant habitats are being submerged and destroyed, and all records of the original native vegetation are being obliterated. Since 1933, when many of the projected dams were being considered by Congress, I have made surveys and collections of the natural vegetation in areas in danger of being flooded. However, it has been difficult to keep up with all the projects under consideration, as each major stream in Missouri has been considered for dam sites.

The opening of new roads into wild and untraveled sections necessitates

Sullivantia renifolia, a rare inhabitant of moist bluffs in remote sections of the state, elsewhere confined to the driftless region in the United States.

Venus's-hair Fern *(Adiantum Capillus-veneris)* on sand bluff near Goldman, Jefferson Co., the northeastern limit of its range in the United States. This graceful fern will be destroyed by dams in numerous sections of the state.

Sand desert on pseudo-island at junction of Missouri and Mississippi rivers, St. Louis Co. In the mud-holes found in the midst of such sand occurs an assortment of moisture-loving plants.

immediate exploration of those areas before they are altered by man. The earlier collectors did not have this problem, because the roads were neither numerous nor improved and the population was not great enough to exert much pressure on the land. Today, one can visit a rich woodland and find plant rarities new to that section, only to discover the following season that the area has been burnt, cut over, grazed, or marred by people not appreciative of beauty or properly trained to take care of its heritage, the outdoors.

As never before, there is need now to preserve what natural flora remains. The plant surveys of Missouri record the existing wild flora throughout the state. Collected herbarium specimens at least will show future generations that certain counties or sections had a particular type of native flora.

Results of Botanical Exploration.—Through intensive exploration during the last twenty years, many new or rare species have been added to the flora in the state. Often, plants previously known from but one station are being re-discovered after nearly a century in some out-of-the-way station. During the past fifteen years approximately a hundred species not previously found in the state, have been collected. This indicates that much yet remains to be discovered.

Program for Future Work.—I have been keeping records showing how often each Missouri county has been botanized, at what months of the year, and the exact locality (township, range, and section) where the collection was made. With such information it is possible to plan in a systematic manner surveys of previously unexplored areas, of which the number is legion. The task of finishing such exploration before many important plant habitats

are destroyed by civilization is herculean. The Missouri Botanical Garden hopes to publish maps showing the exact geographical distribution by counties, of each native Missouri species. While I have been trying to obtain as many records as possible, the task would be simplified if interested persons would send me pressed specimens found in their particular county. If they would communicate with me, I would be glad to furnish suggestions as to areas to visit, species needing to be collected in that county, and other pertinent information. Address letters to Dr. Julian A. Steyermark, Chicago Natural History Museum, Roosevelt Rd. and Lake Shore Dr., Chicago 5, Ill.

Mistletoe *(Phoradendron flavescens)* growing on young sycamore, along Eleven Points River, near Bardley, Oregon Co. The mistletoe is common in the southeastern swampy parts of the state, also along some of the Ozark rivers, but some of the habitats will be destroyed by future dams.

Moist limestone bluff along a creek in a remote section of Howell Co. This is the kind of habitat for such rare species as Showy Lady-slipper *(Cypripedium reginae)*, Venus's-hair Fern *(Adiantum Capillus-veneris)*, *Sullivantia renifolia*, and Grass-of-Parnassus *(Parnassia grandifolia)*.

"OUR NATIVE WILD FLOWERS" RESURRECTED

Dr. Alfred Etter, in a study of the botanical history of the state, called my attention to a paper read by Mr. John H. Tice, Treasurer of the Missouri State Horticultural Society in 1864, at its sixth annual meeting, held in the Supreme Court Room in St. Louis, January 12, 1865. Mr. Tice's "essay," entitled "Our Native Wild Flowers," was published in the first Agricultural Report of Missouri for the year 1865. The essay, replete with the florid phrase and philosophical excursion of that period, is remarkable in that at a time when most counties in Missouri were regarding their lumber supplies as inexhaustible, their rivers and springs "durable" and sufficient for ample industry, and more emigrants the crying need, Mr. Tice foresaw a process of destruction of the wilderness that has not yet reached its end. John Tice's plea for greater use of our native plants as ornamentals is echoed today by many of the foremost landscape men and horticulturists.—R. W. S.

OUR NATIVE WILD FLOWERS

"I wish to enter a plea for the wild flowers of America, a plea to have their merits appreciated for adorning our homes, and a plea for rescuing them from destruction before it is too late. Many localities in the older States, and even many in the new ones of the West, where once the choicest wild flowers abounded and bloomed in the wildest profusion, are now destitute of them. Not even a trace of them is to be found, they having as completely disappeared before the onward march of the white man as the red man has, whose war path they decorated, and whose wilderness home they enameled from time immemorial. The work of destruction is still going on. Year by year they are crowded into narrower limits, and unless the rescuing hand is soon put forth, they, like the red man, their companion through the indefinite past, will live only in story and in song. It is true, a few have been rescued, and now form our choicest floral treasures, among which may be named two varieties of Ipomopsis *(Gilia coronopifolia* and *G. aggregata)*, *Phlox Drummundii* [*Drummondii*], and Corcopis [Coreopsis?] or *Calliopsis tinctoria*. But these, and most other native flowers we cultivate, have come to us from Europe, where they have been carried by botanical explorers, and where they have excited the wonder and admiration of those of cultivated floral taste and of connoisseurs of floral beauty. They could not be received into good society at home before they had received an aristocratic indorsement abroad. Slow as we have been to find out their merits and acknowledge their respectability, we now make amends by displaying them in the most conspicuous places of our gardens, and feel disappointed if our friends do not compliment us for our taste in selecting and displaying them.

"This is only additional evidence of how slow and how long we are in arriving at any truth. The world is a mystery to us—a riddle that puzzles us for a solution. Confronted by this mystery, we yet feel a consciousness that it is our prerogative to know, and that we possess a faculty by which

A view of the bottoms along the once-beautiful River des Peres, near the Broadway Bridge, South St. Louis. Photograph taken in the spring of 1908.

we can know. But instead of exercising this faculty, and by patient investigation, discrimination and comparison, discovering the truth, we set up the phantasms of the imagination for it. For a time, at least, we accept these phantasms as satisfactory solutions of the mysteries of nature. . . . . The child solves for itself the mystery of the flower garden by fancying that the fringes of the rosy morning cloud have descended and settled on the leaves of the plants. When this theory no longer is satisfactory to it, then it fancies that Eve, on her expulsion from the garden, carried the flowers with her. Many people never rise above this childish conception. Flowers they associate with a garden, and regard all gardens as lineal descendants of the primitive one, and, therefore their contents as derived from it. The association certainly is beautiful, and seems calculated to induce every body to create around their dwellings little miniature Edens. This is not all; the idea is suggestive. We are told there was none to till the ground, and the Mighty One created man. To induce him to perform his mission of terra-culture, he planted for him a garden. 'And the Lord planted a garden eastward, in Eden, and there he put the man that he had formed.' It requires no great powers of imagination nor stretch of fancy to conceive this garden embellished with every floral treasure under the sun, and, therefore, as a sequence, that our flowers, as our race, are outcasts from Paradise, their original habitat. I would not, if I could, break up such beautiful associations, but I would extend the limits of their application. The world is the Lord's garden, planted everywhere by him with flowers, from the torrid heat of the equator to the frigid zones. Wherever vegetation springs and man can live, there his abode is cheered, enlivened and decorated with flowers adapted to the climate and locality they are intended to inhabit.

"All flowers were, therefore, originally wild, in some parts of the globe. Some of them have been so greatly improved and changed by cultivation, that their genera and species are only recognizable by professed florists and botanists. These are called 'florists' flowers.' No genera from any part of the world have shown such great susceptibility of improvement as some of the American genera. Take for instance the dahlia, originally a single-rayed, yellow-flowered rough plant from Mexico, now transformed by the art of florists into the most beautiful double flower, displaying every variety, tint and shade of color, excepting blue. Another and a more recent instance, is the transformation of another rough single-rayed Mexican plant into the double zinnia, now becoming a general favorite in our gardens. The innumerable varieties of Rhododendrons that constitute the most attractive gems of European gardens and conservatories, were produced by improving the originals, or by hybrids from the American Rhododendron *maximum* and *R. Catawbiense.*

"It is to be regretted that the Americans have not yet a cultivated floral taste sufficient to appreciate these, the most beautiful of our native flowers. If the domestication of some of our native species has transformed them into choicest floral gems of world-wide reputation, what treasures are yet in store amongst our neglected wild plants to reward the future labors of the florist and botanist?

"Search then among our much abused and neglected wild flowers, and you may find treasures that will reward you a thousandfold for all your labor. If you fail, you will yet find ample compensation for all your pains in the new scope it will give to your thoughts. Your labor will become a labor of love, and before you are aware, it will open up hitherto sealed fountains of enjoyment and pleasure, unknown and undreamed of pleasures that will improve you physically, morally and intellectually.

"In an essay it is only possible to describe a tithe of the native flowers worthy of attention that are springing up around us everywhere. Even in these, with the greater part, the mere naming of them must suffice. In making out the following list I have only named such as occurred to me at the time, and no doubt have passed over others equally as worthy of attention.

"First on the list stands the *Hepatica triloba*, because it is the harbinger of Flora's train announcing her advent, often appearing beside a lingering snow bank. This elegant plant is widely diffused over the continent. I have seen it from Canada to Georgia, and west, to Wisconsin and Iowa. Flowers, pale blue, violet, white and sometimes flesh-colored. In cultivation it becomes double. I have seen them double in the bluff ravines of Iowa.

[There follows enumeration and brief discussion of the following:]

Jeffersonia diphylla
Cucularia [Cucullaria] (or Dutchman's breeches)
Dielytra eximia, *D. formosa* and other species of Dielytria
Anemone nemorosa
Claytonias or Spring Beauties
Viola arvensis and other species of Viola
Delphiniums or Larkspurs (several species)
Silene or Catchfly (10 species)
Cypripedinino [Cypripedium] or Ladies' Slipper (5 species)
Dodecatheon Media
Rhexias, or Meadow Beauties (a number of species)
Campanula or Bellflowers (9 species)
Mertensia (several species)
Lithospermum
Linaria
Aquilegia (Wild Columbine)
Asclepias
Phlox
Penstemon
Amaryllis
Lilium
Erythronium or Dogtooth Violet

SHRUBS AND ORNAMENTAL TREES

Cornus, Dogwood; Chinanthus [Chionanthus], Fringe Tree; Calycanthus, Sweet Shrub; Amelanchier, Service Berry; Cercis, Judas Tree; *Cerasus borealis*, Rocky Mt. Cherry; Kalmia, Mountain Laurel or Calico Bush; and Ilex, the Holly.

VINES AND CLIMBERS

Tecoma, Clematis, Wistaria, Passiflora, Lonicera, Ampelopsis, *Celastrus scandens*, *Solanum Dulcamara*, etc.

EVERGREENS

Epigaea
Chimaphila umbellata
Kalmia
Pyrolas
Rhododendrons (15 species)
Azalea procumbens

"The power that impels us to, or nerves us for the conflict of life emanates from home, and so do the influences that shape and control our actions everywhere. . . . . Home is, therefore, a holy spot. Let it and its surroundings, then, be such as to speak to us of tranquility, order, goodness and beauty. Embellish it with flowers, decorate it with vines and adorn it with trees. Here sow the greensward, and fringe it with the patriotic colors, red, white and blue; there plant the rose, the eglantine, viburnum, syringa, weigelia, the jessamine, honeysuckle, tacoma [Tecoma], clematis and wistaria. Here plant the fragrant strawberry, there the cherry, peach, apple, pear and luscious grape. Collect there whatever is pleasing to the eye or grateful to the taste, and home will be the radiating point of all influences that elevate our thoughts, refine our morals and ennoble our sentiments. Beauty is God's chosen form of power to elevate us and bring us into communion with him. Hence nature is full of beauty, the landscape is decorated with flowers, the old ruin is covered with ivy, and the unsightly tree is hung with festoons by the graceful vine with an elegance and grace that man has never had the taste to imitate. He who cannot appreciate and enjoy the beauties of nature has but poor and few resources of happiness, and lacks an essential element for moral and intellectual elevation and refinement.

"What means then can we command to adorn and render our homes attractive? Besides the taste and skill of the architect, there are many ways of embellishing them. To depreciate architectural beauty would be folly, but the sight of it is painful instead of pleasant if the surroundings do not correspond with it. It then shows that the owner has more money than taste, and more vanity than refinement. A home, whether it be a palatial mansion or an humble cottage, must be surrounded by flowers, trees and shrubbery to make it attractive. Trees are indispensable to set it off and make a distant view of it pleasant. They will cause it to receive the grateful admiration of the passing traveler, but not of our friends who visit us, unless the beautiful distant prospective is carried forward, fulfilling in its minutest details the expectations it raises. For cheerful influences that speak to the hearts of all there is nothing like flowers. . . . . They shed refining influences on ourselves and on our children, mollify and refine our manners, elevate our sentiments, and inspire us with cheerful views of life. Their cultivation is also an evidence of high civilization, a floral thermometer indicating the degree of refinement and intelligence the people have attained.

"Pass through the country. Wherever you find the dwelling without an inclosure, or surrounded by a dilapidated fence, the possession of the yard in dispute between runts of pigs and many dogs, a mete place for the cow to ruminate, but not for the owner; enter there, and the interior of that dwell-

ing corresponds with its exterior, each a reflex of that moral disorder, confusion and ignorance that reign in the hearts and sentiments of the occupants. On the other hand, wherever you find the white paling inclosing the spot sacred to flowers, the vase or flower pot on the gate post, trailing plants adorning and beautifying the walk, or tasteful mound or bed, and concealing blemishes, blooming plants disposed so as not only to please the eye but to load the air with their fragrance; enter there, and you will find the interior of that house to correspond with the exterior, and again both a reflex of the interior mental, moral and aesthetic order that reigns in the hearts and sways the affections and sensibilities of the proprietors. So true is it that a love of flowers is a love of beauty in detail. It is not confined to the garden; it enters the house, disposes of the interior arrangement, selects the library, and molds and controls the mental and moral character of its possessor. Early ought we to cultivate it in ourselves and in our children, so as to impress its power and influence on us and them, to sweeten our tempers, steady our waywardness, gentle our affections, and soften the harsher traits of our natural dispositions.

"Every one who has experience knows that exotics are more or less uncertain and sometimes, in seasons like the past, a total failure. Our native varieties are better adapted to withstand the vicissitudes of our climate, and but little affected either by its variableness or the extremes of its changes. They are not only surer, but many of them are without peers in the floral world. Let us pay more attention to our native flowers; let us rescue them from that destruction to which many of them are doomed with the advance of population, improve them by culture, as most of them will, and we will not only have choice flowers but an abundance of them in such seasons like the past, when exotics fail."

WILDLIFE AS AN INDICATOR OF LAND MANAGEMENT

AUGUST P. BEILMANN

Perhaps the best answer as to how successfully a natural flora has been reestablished might come from the birds and wild animals. They don't have to remain as does a plant—they can fly or walk away from an unfavorable environment. At the Arboretum both the birds and wild animals have continued to increase. This well may indicate that fertility is being maintained and that additional plantings have been well balanced and properly placed. It may indicate that the soil is again approaching the primeval condition; it furnishes a clue as to how the marvelous herds of big game once existed here.

The most spectacular and interesting of the wild residents in the Arboretum from the visitors' point of view are the deer. The herd, now number-

ing over thirty head, began about 1939, with one or two animals driven into the area by dogs. Our first clue to their presence was the total disappearance of several rows of experimental vegetable soybeans. Shortly after this, deer could be seen once in a while, and now herds of 14 animals are not uncommon in certain seasons.

The Mississippi Valley Red Wolf *(Canis nubilis nigra)* is both a resident and transient. Wolves have, on several occasions, raised a litter in a den on the grounds. They range far and wide in search of food—possibly beyond a twelve-mile radius of the den. A mature male may weigh as much as 75 pounds, but normally wolves are smaller and lighter.

Of the smaller fur-bearers native to the locality, virtually all are present in considerable numbers. The red fox has been especially abundant recently, but all species are cyclic and have years of heavy populations and years when they are almost absent. The mink, the red, grey and flying squirrel, the opossum, the racoon, the skunk (at a low ebb recently) are all residents throughout the year. Even the beaver is staging a comeback, along the Meramec River (see May 1949 Garden BULLETIN). Many of these are not predatory, and subsist on fruits and vegetation. Almost any wood-lot will support some game and sometimes much more than we suppose; but when fox, skunk, possum, and the wolf can be seen regularly, there must be adequate food available. It may seem strange to use the wolf as an indicator, but actually a rather large part of his diet is tree fruit, especially plums and persimmons!

The song birds may be a little more difficult to use as proof of consistently well-balanced planting since they are very free to move as they please; but the immense flocks of robins wintering in the glades could not stay without ample food. This is shown by the heavy planting of the whole Arboretum with Juniper seeds expelled by birds in flight. If a mowing schedule were not rigorously adhered to, many areas would grow up to solid stands of the Red Cedar. At least four Red-tailed Hawks are residents, living upon mice which are present in vast quantities. The pileated woodpecker and the owls are here, and even an osprey fishes for his dinner in the lake. The quail, absolute indicators of habitat, have increased to the point where over fifty birds were counted crossing the road at the East Bridge. They appeared to be all in one covey, while smaller covies of twenty birds were the rule during October.

It would seem, then, that the records obtained from these various furred and feathered barometers is good. The land management efforts seem to be aimed in the right direction. The fertility level of the soil must be rising and the wood-lots and plantings are apparently acquiring a biologic balance. The animals and the birds evidently think so or they would run or fly away.

NOTES

Dr. Henry N. Andrews, Paleobotanist to the Garden, spent two weeks in January at the library of the United States National Museum, Washington, D. C., in the preparation of a generic index of all fossil names, being based on the so-called "Compendium Index" started by the U. S. Geological Survey in 1900.

The death of Dr. Jesse More Greenman, who has been associated with the Garden since 1913 as Curator of the Herbarium and Professor in Washington University, but is best remembered as a beloved and admired teacher and colleague, came on Saturday, January 29, 1951. In a forthcoming issue of the ANNALS OF THE MISSOURI BOTANICAL GARDEN, the life and work of this noted scholar will be reviewed by a former student of his, Dr. R. E. Woodson, Jr.

The American Association of Landscape Architects, meeting in St. Louis, January 28–30, visited the Garden January 29, and were conducted through the buildings and grounds by Mr. Pring, Mr. Kohl, and Mr. Cutak, of the Garden staff. In the Museum building Mr. Pring explained the moving pictures showing the "Four Seasons at the Missouri Botanical Garden." Other groups visiting the library and herbarium during January were the "special-libraries" class of Washington University, accompanied by Mr. Jerrold Orne, Librarian; and Dr. Lillian Nagel's botany class of Harris Teachers' College.

Recent visitors to the Garden include Mr. Ken Tsoong-Sien Yao, formerly of Shanghai, China, who is studying agronomy and animal husbandry at Ohio State University, Columbus, and at Louisiana State University, Baton Rouge; Mr. Peter Smithers, member of parliament for Winchester, England, and Mr. E. H. North, Solicitor, of London, England; Mr. B. A. Krukoff, of the New York Botanical Garden; Dr. M. S. Zuber, Agronomist, U. S. Department of Agriculture, and Mr. C. O. Grogan, graduate student in agronomy, both at the University of Missouri College of Agriculture, Columbia; and Dr. Guy Stresser Péan, a French ethnologist *en tour* to Mexico where, under a grant from the Rockefeller Foundation, he will continue his studies, interrupted by the war, of the Huasteca Indians.

THE MISSOURI BOTANICAL GARDEN

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SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 50,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

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Cover: Snow Trillium *(Trillium nivale)*. Photograph by Albert Vatter, Jr.

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NATURALIZING FLOWERS AT GRAY SUMMIT ARBORETUM*

EDGAR ANDERSON

A quarter of a century ago when St. Louis was one of the smokiest cities in America, and getting steadily smokier, the Missouri Botanical Garden sold off a portion originally destined for expansion and with the proceeds bought several hundred acres of rolling farm land on the edge of the Ozarks near Gray Summit. The new property was thirty-five miles from the city garden and well outside the metropolitan area. Its immediate use was for two features which had been most affected by the smoke. Greenhouses for the orchid collection were built on one corner of the plot and a pinetum was laid out and planted, since Henry Shaw's collection of conifers, once one of the best in the country, had been virtually eliminated by the city smoke. These two projects absorbed most of the funds which were available for development.

The success of the St. Louis program for smoke control has made gardening within the city limits increasingly rewarding, instead of increasingly discouraging, and the Arboretum (as it is now designated) has been gradually developed to include a number of features which are either more appropriate or more effective in a country environment.

The Arboretum is over one mile wide and two miles long, minus an irregular piece at the southwest corner. Roughly a quarter of its holdings are on the south side of the Meramec River and this area is operated as a farm, at a modest profit. The remainder of the tract, the Arboretum proper, is made up of two quite different kinds of landscape, which are being managed very differently. Three or four hundred acres adjacent to the river are rough land, rocky in part, clothed with native first- and second-growth forest and including a number of magnificent cedar barrens, or "glades" as they are known in Missouri. The rest of the property, including nearly all the land adjacent to the highway, had long been cleared. It included a few

* Reprinted from *Parks & Recreation* 33:345–346. October, 1950.

Narcissus in the Pinetum of the Arboretum

pieces of excellent soil amid wide areas of exhausted farm land, rapidly coming up to a thicket of blackberries, elm, and occasional cedars. In developing the Arboretum these old fields have been transformed into a series of bluegrass pastures and the woodland area is being developed as a wildflower preserve. A winding gravel road has been built through the grounds, with ample parking space adjacent to the wildflower area.

Since there are virtually no funds for the development or upkeep of the meadow area, the Garden has had to use the natural forces already at work there. By forming a shrewd idea of what was going on it has been possible to pick and choose among various end results. Left to themselves the old fields would have come up to brush which would have taken at least a century to become real woodland areas. They would have been almost totally lacking in woodland wildflowers and the native oak-maple forest would have had to spread slowly in the shelter of the pioneering elms. The cedars would have died out as soon as the developing saplings shaded them too severely. By clearing out everything else and leaving most of the red cedars, we now have a series of undulating meadows dramatically accented with specimen cedars. In the early years these meadows were maintained by mowing; as the Arboretum has developed, an increasing amount of mowing has been done by Aberdeen-Angus cattle. This means that the meadows are now on the black side of the ledger rather than the red. There are, how-

ever, other advantages to the cattle. They help to discourage trespassing by hunters. Visitors to the Arboretum are more readily persuaded to park at the regular parking fields and use the regular trails if they enter through rolling meadows in which cattle are feeding. Mowing the meadows increases the grass and decreases the clover and meadow flowers. Pasturing increases the clover and does not discourage the wildflowers. The meadows are separated from the gravel road by rail fences, which with the native vegetation that has come in along them, serve as nesting and shelter areas for bob-whites and other wildlife. Between the rail fence and the gravel drive, native wildflowers adapted to the site are being encouraged. At a few points appropriate exotics such as autumn crocuses and Hemerocallis have been naturalized.

When it was discovered that Narcissi did especially well over most of the property, large plantings of them were made in the pinetum and in certain of the meadow areas, while variety test plantings were scattered in small groups along the circuit drive. It was soon apparent that though Narcissi are more used for naturalizing than any other plant, little was known as to which varieties were best for that purpose or where they might be obtained. A serious study was accordingly made of the Narcissi. Most commercial and show varieties were found eminently unsuitable; their flowers are so large as to look out of place in such an environment, their stems are weak and the flowers do not stand up well in the wind. As soon as careful and comprehensive trials of naturalized Narcissi had been started, growers, breeders, and collectors of this beautiful genus coöperated to a remarkable extent. The collection has already become one of the country's most comprehensive tests of sturdy and effective Narcissi for naturalizing. Some varieties were acquired by gift, others by exchange, a few by purchase. Several have come from old abandoned homes or from small dooryard gardens where they had been treasured for their reliability. If it is true that "the best things in life are free" it is equally true that the best things in the Narcissi collection were free, or at least they were paid for only in interest and understanding and enthusiasm.

In developing the wildflower reservation, August P. Beilmann, the superintendent, and his assistant, Louis Brenner, have used the same principles of tapping natural forces. When one of the fire trails was cut, redbuds seeded themselves into the cutover area along the trail in abundance. If left alone, the bulk of these seedlings would have been topped by the rapidly growing stump sprouts and within a few years only some of those immediately adjacent to the trail would have been left. By going through this area every few years and cutting back stump sprouts which compete with cedars or redbud and by sowing additional redbud seed in likely places it has been possible to produce cedars and redbud in abundance. The few dogwoods in

Wildflower trail at river bluff in the process of reconstruction.

the area have been encouraged; seedlings raised from them in the nursery have been set out at strategic points. In a few years, by a minimum of expense but with a maximum of understanding and planning, there will be a superlative display of redbud and dogwood, effectively backed up by red cedar foliage.

With the wildflowers themselves a census was taken of the native species already growing on the area and this was carefully compared with the known flora for that part of Missouri. A list was made of all the interesting or spectacular wildflowers which one might expect to find on the area but which were not present. As opportunity offered, a few plants were transplanted from nearby sites to one or two likely locations within the wildflower area. Some have died, others have held their own or slightly increased, and one, the Ozark Calamint, has increased until it now gives a mass display. From these experiences it will be possible to increase any of these species efficiently when funds become available.

A beginning has already been made by Mr. Brenner in building a series of wildflower trails through the area. Enough has been done to show their great potentialities, and the Garden Club of St. Louis is now sponsoring the wildflower trails.

Lumber yard at the Arboretum

One of the most practical developments at the Arboretum has been the establishment of a sawmill and adjacent lumber yard, where trees from old fence rows, windfalls, and thinnings have been cut into lumber, which is used not only in the Arboretum but in other parts of the Botanical Garden.

Another recent interesting development has been the creation of a number of small ponds which serve a variety of purposes. They add to the interest and attractiveness of the landscape, they store water which is used during drought periods in the orchid greenhouse and in the experimental nursery, they serve as habitats for the effective growth and display of different types of wildflowers, trees and shrubs, and in coöperation with the Conservation Commission they have been experimentally stocked with various types of fish.

Book Names versus Common Names.—Common names belong to the people and all the efforts of all the professors make little headway in establishing an invented name. The books say that the common name of *Erigenia bulbosa* is "Harbinger of Spring" but country children call it "Pepper and Salt." Both names are appropriate. It blooms so early that it is a real harbinger, that is, a forerunner. Strictly speaking, it is not a spring wild flower; it blooms just ahead of spring and lets us know that spring is around the corner. But "harbinger" is a book name; it is not in the speaking vocabulary of an ordinary person, so "pepper and salt" wins the contest hands down. It persists as the common name. It too is appropriate. The flowers are borne close to the ground in flat diminutive bunches, small white petals and black-purple stamens all intermingled so that the blossom looks like the mixture of pepper and salt one carries on a picnic for his hard-boiled eggs.

TEN MISSOURI WILD FLOWERS FOR ST. LOUIS GARDENS

EDGAR ANDERSON

Given a tract of land in the country nearly any one can naturalize a large number of wild flowers successfully. Given some experience with gardening one can make many Missouri wild flowers grow and even increase on a suburban lot, as Mr. Bill Bauer once demonstrated so effectively in Old Orchard. If the ordinary person with an ordinary garden, however, is going to be advised which native wild flowers to begin with, we shall have to be really choosey in making out a list. We must not include rarities which he is likely to kill in the transplanting. We must not have plants which will get rank and coarse and look out of place in an ordinary garden. We must not have plants whose requirements as to light and shade and soil are so special that they flourish only with expert attention or in the one garden in fifty which happens to have the exact conditions they require. The following list includes only plants which are known to be adaptable, which are in no immediate danger of extinction, which can be transplanted successfully by the ordinary person, and which will not look out of place in a back-yard garden. They are listed roughly in the order of bloom and should provide interest and occasional flowers for cutting from mid-April to mid-October.

Uvularia grandiflora (Bellwort).—This common woodland plant, with its large drooping yellow flowers which never open out, flourishes in semi-shade and does not seem to mind city conditions. It has done well in several gardens east of Grand Avenue in the part of the city which one ordinarily thinks inhospitable to wildlings. To be effective it needs to be planted in bold clumps. The yellow flowers are interesting and beautiful in their own way, though they are not good for cutting and do not make masses of color for the garden picture. They are succeeded by the mature foliage which is so classic in its perfection that it adds distinction to the flower border throughout the rest of the season.

Podophyllum peltatum (May-Apple).—May-apple stands transplanting well and will always grow for a season or so when brought into the city. If it is to flourish for years it requires a deep rich soil and partial shade. It is thoroughly at home in several old gardens in the city. My own garden, which is built on filled land and has only three to six inches of soil above many feet of ashes and rubble, is too dry in dry weather and the plants get smaller every year and eventually die out.

Penstemon Digitalis (Foxglove Penstemon).—This is the last of our two common Penstemons to blossom. It is tall and lusty but not rank, and covers lowland meadows along the Meramec bottoms with its attractive sprays of large white flowers. Though it grows naturally in quite wet

Uvularia grandiflora at the Arboretum

places it will do amazingly well in an ordinary perennial border and only requires a reasonable amount of watering.

Monarda Bradburiiana (Ozark Balm).—Unlike the other Monardas, this species blooms in the spring rather than in midsummer. Its rosy pink flowers are highly fragrant and it varies a great deal from plant to plant. It is worth while trying to make a collection of forms selected for the pinkness of their bloom or the delicacy of their scent. With ordinary care it increases slowly from year to year in the perennial border but never becomes weedy.

Monarda fistulosa (Lavender Balm).—This is a taller plant than the preceding and a native of road-sides, sunny pastures, and wood edges, rather than a woodland species. Its beautiful lavender flowers are attractive in flower arrangements and contrast well with some of the paler day-lilies which blossom at the same time. It is sometimes rather on the spready side but can easily be controlled by pulling up the offending rhizomes while the plant is in flower.

Bellamcanda chinensis (Blackberry Lily).—Is the blackberry lily a garden flower or a wild flower? Well, for all practical purposes it is a wild flower in Missouri. It is so thoroughly naturalized here not only along road-sides but even on remote limestone hillsides, that only scholars are conscious that it was brought in from the Orient in colonial times. It looks like an Iris until one pulls up the root and finds that it is orange-red in color. The blossoms, borne in mid-summer in a flat spray, are terra cotta with cinnamon-colored spots. They vary a good deal, and one can locate superior forms by keeping his eye out for them. For no particular reason it has become rare as a garden plant and deserves being re-introduced into polite society.

Eupatorium coelestinum (Mistflower).—This spready little plant has flowers of the same misty blue as the Ageratum used as a bedding plant, and many people refer to it as "Wild Ageratum." It has a bad reputation as being almost too weedy for the perennial border but it is easily kept in check by pulling it up when it is in full bloom from the parts of the garden where it is not wanted. Its spreading propensities can be a real blessing since it will automatically come in where other plants have failed and prevent the growth of less desirable weeds. By keeping a strict watch one may occasionally find a pure albino form (there are also closely related species with white flowers but they have different leaves). If the blue and the white are allowed to grow in among each other they give a beautiful play of color in late summer and early autumn.

Allium stellatum (Rosy Allium).—This beautiful bulbous plant blooms from late summer until October. It can be transplanted easily at any time of year and it is not difficult to raise from seed, though several years are required before the bulbs are of flowering size. The leaves, which appear in early spring, are sprawling and rather ugly so that it is best planted near larger perennials which will hide the leaves but give room for the graceful flower clusters to shoot up. The rosy pink of the flowers is particularly effective when combined with the soft blue of the Mistflower which blossoms at the same time.

Aster turbinellus (Ozark Aster).—This bright blue aster is found on rocky soils throughout much of the Ozarks. Of all the native species of Aster it is the easiest to grow year after year and one of the most beautiful

in cultivation. It does not become coarse and weedy but it branches out amazingly to make a mound of brilliant blue bloom in late September and early October. If two plants are brought into the garden they will cross-fertilize each other naturally and an abundance of seedlings will come up from which one can select superior forms.

Helianthus Maximiliani (Prince Maximilian's Sunflower).—If this lusty sunflower is brought in from the wild, one will probably not have so good a garden plant as the strain which is common about St. Louis and which seems to have been in cultivation here for many years. It requires sun to do its best, and given plenty of room it will make tall wands of gold, which however are not coarse. It increases rapidly but tends to make a solid clump which can be kept in check by dividing the plant every few years.

THE SNOW TRILLIUM

JULIAN A. STEYERMARK

If you contemplate participating in some kind of treasure hunt, try hunting down the Snow Trillium or Wake Robin *(Trillium nivale)*. However, you must start looking for it in March and early April, for it is the earliest of the trilliums to bloom. Thrusting its short stem and showy upright white flower above the ground regardless of the blustery cold blasts, snows, or frozen ground that often prevail during March, it may be the very first herbaceous wild flower to appear in bloom in Missouri. It sometimes even "beats" the Hepatica, Least Bluet, certain buttercups, Whitlow Grass, Androsace, and other early claimants for the "first-to-bloom" honor in Missouri. (Skunk Cabbage is early but it is not known to grow in a wild condition in the state.) No more beautiful sight can be imagined than hundreds of these dainty fresh white blossoms closely hugging the dark brown soil. (See illustration on cover.)

Botanical exploration has now shown that the Snow Trillium grows wild in Missouri in eight counties (Clark, Lewis, Ralls, Pike, Lincoln, Monroe, Callaway and Texas), seven of these stations having been located by the writer. There is a colony in Franklin County at the Missouri Botanical Garden's Arboretum but these plants were introduced from another locality.* It will be noted that except for Texas County all the counties mentioned are located north of the Missouri River in the northeastern part of the state. Surprisingly, the seventh edition of Gray s *Manual of Botany*, published in 1908, did not even record this species for Missouri, its range being given as

* The colony from Iowa stock planted in 1944, near the East Bridge at the Arboretum, is holding its own.

"W. Pa. and Ky. to Minn. and Ia." The first actual herbarium collection was more or less accidentally discovered in 1934, when I was engaged in the preparation of the "Annotated Catalogue of Flowering Plants of Missouri." I was studying all the dried plant specimens preserved in the herbaria of the various colleges and universities in Missouri, and in the herbarium of William Jewell College, I found a specimen of *Trillium nivale* collected by Professor L. W. Elmore, on March 21, 1919, from woods along a creek at Fulton, in Callaway County.

In April, 1935, specimens of Snow Trillium were collected in Texas County along the Jack's Fork of Current River, the most southern of known Missouri stations for this species. Since the plants were almost past good flowering condition, I took another trip to the same locality in March of 1950 to verify their occurrence, and to my delight a carpet of beautiful white Snow Trilliums covered the steep wooded slopes and rocky limestone outcrops.

A study of the seven other stations where the writer has found the species reveals that the Snow Trillium apparently has a preference for steep, north- to northeast-facing wooded slopes along streams where limestone rocks outcrop and Sugar Maple *(Acer saccharum)* dominates. In fact, a knowledge of this particular type of habitat has enabled me to discover the new stations in Missouri. Each locality has in common the limy or alkaline soil, steep slopes along a stream, shaded mostly north-facing exposures, and a forest cover predominantly consisting of Sugar Maple. In a recent Garden Bulletin,* Dr. Edgar Anderson pointed out that in Iowa and Illinois the plant was found on river terraces. However, both in the unglaciated sections of Ohio and Missouri, as well as in the glaciated parts of Missouri, the plant was observed growing along eroded stream slopes or bluffs, but not on terraces.

The species apparently does well when transplanted to woodland wild-flower gardens having good drainage and a mostly alkaline to circumneutral soil. Missouri plants transplanted to the author's wild-flower preserve in northeastern Illinois have prospered and multiplied during the past five years.

Crocus Tommasinianus is one of the best extra-early crocuses for St. Louis gardens but it varies a great deal from one strain to another. Some one should make a special study of its varieties.

Have you ever noticed that the blossoms of the Silver Maples sometimes appear to be brilliant dark red and sometimes a sort of smudgy yellow-brown? That is because the male and female flowers are frequently borne on separate trees, the male with yellow stamens and the female with red stigmas.

*Bull. Mo. Bot. Gard. 33:227. 1945.

SPONTANEOUS WILD FLOWERS

LOUIS J. BRENNER

Today as we become increasingly conservation-minded we welcome any small indication that our conservation effort is leading us in the right direction. From bitter experience we have learned that it may take longer to correct the results of wasteful management than was required to effect the degraded condition. Following the purchase of the Arboretum, twenty-six years ago, it was imperative that an extensive erosion control program be enacted if plant habitats were to be maintained or developed. Today the effectiveness of our efforts toward the retention and addition of top soil, with a consequent increase in soil fertility, has been pointed out in a very significant and interesting manner.

Twenty-nine years ago the Garden BULLETIN published an article, "Vanished Plants of Our Local Flora." The author* reviewed the "Preliminary Check List of the Cryptogams and Phanerogams in the Vicinity of St. Louis, Missouri" published by the Engelmann Botanical Club in 1911, and found that in the eleven years following its publication man had so modified the surrounding country that many of our loveliest and most unusual wild flowers had been eliminated and even greater numbers imperiled. A list of species which had vanished from our local flora at that time through pasturing, cultivation, drainage, and vandalism was also presented. It is of great significance that four species which appeared in this list of vanished plants are now a part of the natural and native flora of the Arboretum, which lies in the western limits of the area included in the check list of the Engelmann Botanical Club. The species of particular interest are: the Pale Gentian, *Gentiana flavida;* Crested Coral-root Orchid, *Hexalectris aphylla;* Lyre-leaved Sage, *Salvia lyrata;* and the Wood Lily, *Lilium philadelphicum.* It is also significant that the acquisition of these plants has been accomplished through natural means of dispersion rather than by the efforts of man. Furthermore, since these species are generally uncommon in the neighboring areas, and show marked reluctance to adapt themselves to man's activities, the rapidity with which they are increasing is looked upon as a very important index of the effectiveness of our efforts toward conserving and reestablishing favorable plant habitats at the Arboretum.

The history of land use of the area embraced by the Arboretum has shown how intense has been the exploitations of man at the expense of a fertile top soil. Decline in soil fertility, together with seasonal ravages of fire and

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* [Jensen, L. P.] Mo. Bot. Gard. Bull. 10:28–32. 1922.

Gentiana flavida, rare, lovely, now well established at the Arboretum.

livestock feeding on an ever-shortening range, has brought about the elimination of these species. The Pale Gentian, a plant of dry rocky hillsides, will suffer seriously from the erosion following excessive pasturing of woodland areas. In its habit of summer growth and fall flowering it is attractive as a forage plant in a season when most herbs are withered from drought. The thick, fleshy roots of the Crested Coral-root Orchid are eagerly con-

Hexalectris aphylla, a unique saprophytic orchid found on dry hillsides in August

sumed by hogs, customarily forced to forage for mast and roots throughout the Ozarks. The Lyre-leaved Sage forms a part of the early green herb pasture sought after by all livestock in the spring before grasses come into active growth. Finally, the Wood Lily, resembling the common Turk's Cap Lily of our gardens, with its succulent stem and bulbous root, can hold no place in areas where livestock are certain to feed on the stem and bulb or the unthinking picnicker gathers the showy flowers.

The exact conditions favoring the reappearance of these species might well cause considerable speculation. It is probable that isolated plants found ample refuge in tiny niches of unaltered habitat near by, where they prospered until desirable areas were again available. Seeds of these species are, for the most part, light and easily carried about by the strong winds prevailing in late summer. At this time the problem is not one of seed source, which is apparently ample, but rather the quality of available habitats. Early attention toward the general improvement of the many plant habitats contained in the Wildflower Reservation of the Arboretum is paying a large reward today. Such volunteer appearance of new species has eliminated the costly and somewhat questionable practice of attempting artificial introduction of these plants.

BROCCOLI FOR THE HOME VEGETABLE GARDEN

ROBERT W. SCHERY

Many vegetable gardeners think of broccoli in terms of something unusual—too difficult to toy with in the home garden chiefly accustomed to tomatoes, corn, snap-beans, beets, and similar easily grown crops. Yet in time and effort spent for a given volume of crop, broccoli need take a back seat to none of these (save perhaps tomatoes). The unusual productivity of broccoli results from its habit of growing additional smaller heads on secondary lateral shoots that develop after the main head or flower cluster is taken. As long as the developing heads are harvested there will be continuous production of lateral shoots until the hot weather of late July and August writes *finis* to the broccoli, or until drought and age make the pickings too bitter for ready acceptance. Broccoli may thus be in continuous production from early May until August,* with a garden patch of some dozen plants producing all the broccoli an average family of four would care to consume during that period. Add another dozen plants and there should be broccoli aplenty for the freezer. And few vegetables freeze better or more attractively than broccoli, lightly scalded before packaging.

* In cool moist summers, as 1950, harvest may be possible all through summer into autumn.

In the cabbage clan, the species *Brassica oleracea*, including such a diversity of vegetables as cabbage, cauliflower, heading broccoli (much like cauliflower), Brussels sprouts, kale, and kohlrabi, none exhibit quite the cut-and-come-again propensity of sprouting broccoli. A cabbage plant, once yielding a head, will later furnish a few small headlets from the upper leaf axils, these about the size of Brussels sprouts; cauliflower, once cut, will yield nothing more; and so on with the other members. But sprouting broccoli will push up repeatedly, in a few days, numerous small flower clusters that make just as good eating, if not so attractive a table display, as the original large central cluster.

A sprouting broccoli plant as it looks in late summer after repeated harvests of the flower-heads and headlets. Although the headlets are quite small they are delicious eating where "show" is not prerequisite. To insure continuous "heading" all heading clusters should be removed at this stage whether to be eaten or not.

Broccoli, like its other cabbage relatives,* is a cool-weather plant. It does best in St. Louis in the spring of the year—or, but less satisfactorily, planted late enough in summer to escape most of the summer heat but early enough to yield inflorescences before heavy frosts. Hardened off in a cold-

*Relatives of broccoli, not of the same species, i.e. not *B. oleracea*, include: Indian Mustard, *Brassica juncea;* Chinese Mustard, *B. chinensis;* Chinese Cabbage, *B. pekinensis;* turnip, *B. rapa;* and rutabaga, *B. napobrassica*, presumably a hybrid between turnip and cabbage.

Portion of broccoli patch in late summer in a small home garden. Corn and beans (background) have been harvested, but tomatoes (between broccoli and beans) continue to bear into autumn.

frame, broccoli is remarkably resistant to cold, and can withstand in the spring repeated light frosts and continued cold weather. In order to get the jump on summer, broccoli is best started under glass in very early March. Plantlets may be hardened off in the cold-frame late in the month, for outdoor planting in April. At this time the seedlings will be a few inches tall, and so like cabbage seedlings as to be indistinguishable. They should be planted no closer than 2 feet apart, for ultimately they become quite large plants.

In the cool moist weather of April and early May the plantlets grow vigorously. They form tall, erect stems with large expansive leaves and then cease altogether to resemble cabbages or other varieties of *Brassica oleracea*. Plants may be three feet tall and nearly as broad when the central heads are first ready for harvest in late May. These may be cut out with a knife, or in their crisp tenderness cleanly broken with a twist of the wrist. From then on it is just a matter of visits every few days to the vegetable garden to gather other (secondary) heads as they develop.

A legitimate complaint, of course, against the growing of broccoli is the bother of starting seedlings in the greenhouse, hot-bed, or basement window and transplanting to the garden. Yet once this has been accomplished most of the work in growing broccoli is behind the gardener. Thereafter the plants

grow so vigorously as to more than hold their own against weeds, so that only limited weeding is necessary. Even the planting and transplanting is not tedious, as with, say, fragile onions. Broccoli seeds are large enough to handle easily, germinate well in a flat of almost any soil mixture or rooting medium, become large and stout and transplant readily with almost no loss. Because seedlings are so large, caution should be taken not to sow the seeds too closely in the flat—a common mistake with the inexperienced. If the seedlings are planted no closer than twelve to the row with about 1½ inches between rows, not only will they be healthier and stronger, but transplanting will be facilitated with minimum set-back because of root loss.

Once started outdoors, broccoli is fairly immune to disease and insect attack. The worst pest is the common cabbage butterfly, the larvae of which consume the foliage. Even here the trouble is minimal compared to what might happen to cabbage or cauliflower, for sprouting broccoli does not have the flower heads (or leaves) enclosed in a tight clump or ball of leaves—where the worms can thrive unmolested by natural enemies or sprays. Arsenical stomach poisons are not recommended for broccoli (or other members of the cabbage group), since human beings will ultimately consume parts that have been so sprayed. Some of the newer insecticides may be effective, but nothing proves better than the old favorite, rotenone. Quick dusting with rotenone powder three or four times during the growing season is all that is needed to afford protection for broccoli against cabbage butterfly. Rotenone is, of course, non-toxic to warm-blooded animals. Besides insects, growers of broccoli may have some "rabbit trouble," for young broccoli and cabbage plants seem to be a rabbit favorite when first planted, before much spring greenery is evident.

When you thumb through the seed catalogue in eager anticipation of a spring to come, check off a packet of sprouting broccoli seed. Either "de Cicco' or "Calabrese' will thrive in St. Louis. A few broccoli seeds started in March, when gardening is dull outdoors anyway, will likely pay big dividends come June.

HARBINGERS OF SPRING

FRED G. MEYER

The first week of March the beginnings of spring 1951 were already in evidence at the Garden. It is always tantalizing to anticipate and then discover that "first" Snowdrop or first full-blown spray of the Silver Maple. These and several others are, with us, real harbingers of spring. Some will flower more sporadically than others, depending upon weather conditions

affcting the St. Louis area from year to year. But the following seven species will almost invariably make the first dent of spring in the city Garden:

Species	Habit	Floral Effect
Snowdrop *(Galanthus nivalis)*	Herbaceous	Plant 2–5 inches long, drooping milk-white flowers
Pussywillow *(Salix discolor* and *S. caprea)*	Large shrubs	Erect catkins
Silver Maple *(Acer saccharinum)*	Tree	Masses of colored bracts and stamens
Cornelian Cherry *(Cornus mas)*	Large shrub	Heads of yellow flowers
Elms *(Ulmus* spp.)	Trees	Masses of colored fruits and stamens
Hazelnut *(Corylus avellana)*	Shrub	Drooping brown catkins
Crocus *(Crocus* spp.)	Herbaceous	Shades of white, blue, and orange

These "early birds" of the flowering plants rarely fail to incite the "gardening instinct" or power of the "green thumb" during this first vernal episode. From year to year the flowering dates of these plants will vary, but they will almost invariably be first on the list. In the April 1950 Garden BULLETIN Dr. Schery reported flowering dates over the past five years for many of the early-flowering plants in the Garden.* It was noted, for instance, that in 1950 the Snowdrop flowered on January 23. But despite this year's sub-zero temperatures during January and early February when practically nothing was in flower in the Garden (except the precocious Witch-Hazel, *Hamamelis vernalis*, which really finishes flowering in January), the opening of spring, 1951, would seem to be at this date just about normal.

NOTES

Mr. George H. Pring, Superintendent of the Garden, attended the trustees' meeting of the American Orchid Society, in Boston, March 12. On March 11, he acted as one of the judges at the spring flower show of the Massachusetts Horticultural Society.

The first number of Volume XXXVIII of the ANNALS OF THE MISSOURI BOTANICAL GARDEN was issued during the month. This number represents Part V, Fascicle 3, of Woodson and Schery's "Flora of Panama," being the second installment of the Leguminosae.

Recent visitors to the Garden include: Mr. Robert Kosankie, of the Illinois Geological Survey, Urbana; Dr. G. Shiriaev, formerly Curator of the Herbarium and Professor of Botany, Masaryk University, Brnô, Czecho-

* In the April BULLETIN it will be possible to compare springtime of 1951 with preceding years.

slovakia, now a resident of St. Louis; Sisters Mary Aloyse Ellingson and Mary Nolasco Cecil, of the Loretta Academy, Kansas City; the biology classes of Lebanon, Ill. Community High School; and a group of botanists from Southern Illinois University, Carbondale, accompanied by Dr. Margaret Kaeiser, Dr. Voight, and Dr. Raymond E. Hatcher, of that institution.

Mr. John Finan, formerly a student in the Henry Shaw School of Botany, now State Department Fellow from the department of history at Harvard University, recently stopped over at the Garden on his way to Mexico where he will study for a year in completion of his doctor's thesis on "Maize in the Culture of New Spain in the 16th Century." Mr. Finan's master's thesis, which was published in the Garden ANNALS, was recently reprinted in book form by *Chronica Botanica*.

After fifteen months in Great Britain and on the Continent, Dr. Fred G. Meyer, of the Garden staff, returned late in January to take up his duties at the Garden. In London, Dr. Meyer worked in the herbarium at the British Museum (Natural History) and the Royal Botanic Gardens, Kew. Horticultural work was carried on at the Royal Horticultural Society Gardens, Wisley, some 25 miles from London. Visits to outstanding gardens in Scotland, Wales, and England were also a part of his program. During the summer of 1950 a six-weeks trip was taken to the important botanical institutions in Paris, Geneva, and Strasbourg.

In mid-February Dr. Edgar Anderson, Geneticist to the Garden, returned from a seven-weeks trip to India where he was the American delegate to a symposium on "Plant breeding and the origin of cultivated plants in southwestern Asia" which was organized by UNESCO. In addition to participating in the symposium at New Delhi, Dr. Anderson attended the Indian Science Congress at Bangalore and lectured at Central College, and at the universities of Delhi, Lucknow, and Allahabad. He spent two weeks at the Indian Agricultural Research Institute at New Delhi working and conferring with various members of the staff on plant breeding problems. On his return trip Dr. Anderson spent a week in England visiting a number of universities and research institutions. At the Royal Botanic Gardens at Kew he lectured to a group of experts from various parts of England who are interested in the Species Problem. He visited the Royal Horticultural Society's Gardens at Wisley, the new laboratories of the John Innes Horticultural Institution at Bradfordbury, and lectured at Oxford and Manchester universities.

SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 50,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

THE MISSOURI BOTANICAL GARDEN

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AGAVES—POTENTIAL SOURCE OF A NEW DRUG?

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During the early years of World War II, the German pilots who guided the powerful fast-diving Stuka dive bombers over the European and North African battle fronts suffered a form of fatigue which often put them in rest sanitariums and incapacitated them for further fighting. Later it was rumored that the Luftwaffe airmen were receiving injections of an anti-fatigue hormone which enabled them to fly and fight at high altitudes. This hormone, desoxicorticosterone, was supposedly extracted from adrenal glands of cattle, and in its production certain plant steroids were also thought to be employed. When the United States Government became interested in the production of adrenal cortical hormones, one of the chemists assigned to work on this problem was Dr. R. E. Marker, then of Pennsylvania State College, who has been responsible for much of the chemical and biogenetic work of the plants tested.

Our story now jumps to Cortisone. The drug is currently assuming importance in the treatment of various non-microbic diseases such as rheumatoid arthritis, rheumatic fever, sciatica, etc., and is even being tried for superficial eye injuries. It is reported to be a hormonal steroid isolated from extracts of the beef adrenal cortex. At least eighteen years of research and extensive expenditures went into its development before it became available to clinical medicine in 1949. Those who wish further general information concerning it are referred to articles in the February, March and May issues of *Chemurgic Digest* (1950), the October 1950 Merck Report, and the Merck *Annotated Bibliography*, the last consisting of abstracts of papers on cortisone and related hormonal structures, where the history, development, chemical and biochemical aspects, and effects of cortisone on non-microbic diseases is covered. Merck & Co., Inc. has also published a syllabus of in-

formation essential to the safe effective use of Cortone, trade-name for its brand of cortisone.

Desoxycholic acid is a primary material in the manufacture of cortisone, and since there is reportedly a limited world supply of the acid, chemists have begun looking for basic materials derived from plant sources. This problem is still very largely in the hands of the chemists. Merck & Co., Inc., for example, is making a concerted effort to expand production and to develop ways of producing cortisone abundantly at a lower cost. In 1949 a gram of cortisone cost $150–$200; today it is listed at $19.20 wholesale. Once again, the Garden is aiding in the research by supplying such botanical information as is useful to chemists.

Shortly after chemists began examining plants for potential sources of a starting material, Strophanthus came into the limelight. This plant reportedly contains steroid molecules with pronounced cardiac toxicity. A specimen of *Strophanthus sarmentosus* has been on exhibition in our Plant Curiosity House since 1943. This species is not being seriously considered at the moment, however.

A group of plants which is said to yield potential starting materials for cortisone synthesis includes species of Dioscorea, a genus which contains the tropical yams (not sweet potatoes), many of them edible.

During a visit to the Garden Dr. Marker interviewed the writer concerning habitats, ranges and species of Agave to be found in the southwestern United States and Mexico. Dr. Marker made at least two trips to Mexico and tested a number of wild species of Agave. Although the work was of a secret nature, it is known that he found anti-fatigue hormone substances capable of being derived from certain species of Yucca and Agave which contain chemical intermediates.

To the natives of tropical North America Agaves or Century Plants were often food, drink, and clothing prior to the coming of the white man. When the leaves were removed from the plant a cabbage-like head or core remained and this was roasted in underground pits, in the same manner as the Hawaiians are said to roast pig. The baked cores were prized delicacies. Remains of mescal pits can still be found throughout the Southwest where Agaves grew in abundance. Before flowering the Agave plant stores up quantities of sugary *agua miel*, or "honey-water," which is gathered by the *peon* and fermented into the beverage called *pulque*. Sisal, henequen and similar hard fibers today come from leaves of species of Agave cultivated especially in Africa and Java.

Agaves are characteristic plants of North American deserts. Their greatest concentration occurs on the dry tableland of Mexico. In the United States their range extends as far north as Utah and Nevada and one species

Agave Parryi at Mt. Mingus, Arizona.

is even native to Missouri. The southern range extends through Central America to the upper Andean region in South America. The plants are found also in the entire chain of West Indian islands. Like some of the cacti, these strictly American endemics have now become naturalized in many warm parts of the Old World, particularly in the Mediterranean regions, South Africa, India, Hawaii, and the Philippines.

The plants are characteristically stemless or short-stemmed and produce many thick fleshy leaves in a close rosulate tuft. These rosettes may be several feet broad but there is one species that does not exceed two inchés. The leaves, with broad clasping bases, are usually quite stiff and frequently armed with stout spines and marginal prickles. The flowering stalks may sometimes rise to a height of more than twenty-five feet, uniquely picturesque in the desert environment. Those who have seen Century Plants in

bloom, especially when planted in rows along roadsides, can, with a little imagination, visualize a picture of telegraph poles minus the wires. A clever cartoon of a hypothetical *Agave telegraphica* reproduced eighty years ago in *The Garden*, an English publication, more effectively dramatizes the tall Agave flower-stalks than any lengthy word picture could.

In the wild some Agaves may attain maturity in four or five years, while others may take three to four times this long. Transplanted indoors they have been known to wait two or three generations before they condescend to produce a flower-stalk. It was thought that they required a hundred years to flower,—hence the name of "Century Plants."

Agaves propagate very easily. Many of them increase by underground rhizomes and may become a nuisance when planted permanently in conservatories. New shoots spring up among adjoining plants, often uprooting them; or they manage to push between rocks where it is next to impossible to dislodge them. Despite this characteristic, all of the species make handsome pot or tub specimens for lawns, terraces, rock gardens and patios. In Mexico and other tropical regions Agaves are often planted in hedge-rows. They are tolerant of almost any kind of soil and will thrive if given plenty of water and sunlight. Established plants can survive protracted periods of

Agave atrovirens—"The *Pulque* Plant of Mexico"

Agave chrysantha blooming in the Cactus House, June 27, 1940

drought because of the quantity of mucilaginous liquid stored within their stems and leaves.

Agaves produce seeds in great abundance and, as a rule, germinate favorably in the greenhouse. The seeds are thin and flat, arranged in rows in a dry globose to cylindric capsule which generally opens at the top. The dry pods are often used in winter bouquets and lend themselves nicely to metallic paints. At the 1949 convention of the Cactus and Succulent Society of America in Phoenix, Arizona, the newly crowned Cactus Queen carried a bouquet of dried desert material in which dried fruit stalks of Agave were prominently featured.

Agaves play a prominent part in Mexican economy. The thick fleshy leaves of some of the species contain a large quantity of strong fiber from which sacks, ropes, saddle-cloths and even garments were made. Sisal is the

most important of these fibers, and the industrious Maya Indians of Yucatan developed several varieties of it. One, known as *Saqui (Agave fourcroydes)*, furnishes the principal bulk of the sisal hemp of commerce; the other, known as *Yaxci (Agave sisalana)*, produces less fiber but excels the former in softness, flexibility, and luster. The native method of extracting the fiber was tedious work. The leaves were crushed or scraped with knives by hand, exposed to the sun and washed before the fibers could be collected. Machinery is generally used today to strip the fibers. Leaves are fed into the machine in their green and succulent condition and are automatically decorticated, scutched, degummed, and freed from pulp stain. Then they are dried in the sun (which bleaches the fiber), stored, baled and delivered to market.

Agave lechuguilla is another important fiber-producing plant, which covers thousands of acres in western Texas and northeastern Mexico. The fiber, known as *Ixtle*, is used for coarse ropes, brushes, and ore sacks. It is similar to other Agaves in manner of growth but is comparably smaller and has vicious spines. The leaves are cut, mashed, and then hackled to produce a fiber of short length.

In some parts of Mexico Agave leaves are used by the poorer classes to thatch their cottages. When cut for the purpose of roofing, the leaves much resemble round tiles. Pins and needles are made of the thorns at the extremity of the leaves. Prescott in "The Conquest of Mexico" states that a sort of paper was made from the leaves, which, when properly dressed and polished, is said to have been more soft and beautiful than parchment. The curious Dresden Codex is claimed to be made of this material. Several other articles are either derived or made from Agaves, but one of the best-known products is *pulque*, the universal drink in Mexico. The variety which offers the best *agua miel* for this beverage is *Agave atrovirens*. It is cultivated extensively just as is corn in the United States. The tourist driving along the Pan American Highway leading to Mexico City will come upon endless fields of *pulque* plants as he nears the capital. It is here that they grow to perfection in the semi-arid sandy soil, where the elevation averages about 7,000 feet above sea level.

When a plant reaches maturity an asparagus-like stalk forms before flower branches make their appearance at the top. In *pulque* plantations this flower-stalk is not allowed to develop. The *pulque* operator *(tlachiquero)* cuts out the central apical bud and scoops out a cavity in the fleshy stem into which the juice, which would have gone to nourish the flowers, slowly accumulates. The juice is either scooped out of the hollow or sucked up through a long gourd and deposited into a goat-skin or sheep-skin bag slung across the shoulder. It is then brought to a central station and emptied into large vats for fermenting. The sweetish, slightly acid, greenish to yellow "honey-water"

Agave pruinosa, blooming in the Cactus House, 1945

is said to contain valuable nutrient and tonic properties but when fermented becomes cloudy, as though mingled with milk. It is considered healthful when taken in moderation, having a special action on the kidneys. As the beverage is a cheap alcoholic drink *pulque* drinkers generally imbibe too freely and consequently become stupefied. Fortunately, the higher class of Mexicans abhors *pulque* and *tequila*, realizing that if better use of the *maguey* could be made the country would be far better for it. Perhaps the potential source of anti-arthritic hormones might be the answer to their prayer!

Tequila is an even more powerful "fire water" than *pulque*. This brandy is similar in appearance to gin and is violently intoxicating. It has reportedly been at the bottom of many an uprising or revolution. Contrary to general belief, *tequila* is usually not obtained from the same species as *pulque*. It is made from the roasted or baked cores of certain narrow-leaved Agaves. While

still hot and steaming the material is taken to a stone-paved pit where it is crushed and ground into pulp, and the semi-liquid mass transferred to vats for fermentation. It is then distilled.

At one time the living Agave collection at the Missouri Botanical Garden was very extensive. The plants were grown in tubs and large boxes, placed outdoors during the summer and stored indoors during winter. The late Dr. William Trelease, first director of the Garden, made a special study of these plants and his monographs, even today, are recognized as authoritative. The writer has attempted to build up the Agave collection in the past few years to its former eminence and already more than fifty species are planted out in the beds of the Cactus House. Some of the more conspicuous species of Agave include the following:

atrovirens
attenuata
Botteri
cacozela
cantula
cerulata
chiapensis
connochaetodon
datylio
decipiens
eborispina
elongata
Ferdinandi-Regis
ferox Bonnetiana
filifera
fourcroydes
Franzosinii
Ghiesbreghtii
Goeppertiana
gracilipes
heteracantha
huachucensis
indagatorum
intermedia
lechuguilla
mitis
mitraeformis
Beaulueriana
Murpheyi
Nelsoni
oblongata
panamensis
Parryi
parviflora
pruinosa
pumila
Roseana
rubescens
Sartori
Schottii
Shawii
sisalana
stricta
vexans
Victoriae-Reginae
Wercklei

In 1947 the writer collected seven Agaves in the Mexican States of Chiapas, Michoacan and Oaxaca and these are now nicely established in the Cactus House. As yet their identity has not been determined, but at least one appears to be an undescribed species. It is a low, soft-leaved plant that grows in mat formation. It was found in a natural rock garden at Nizanda, Oaxaca.

EVALUATION OF A SELECTIVE CRABGRASS KILLER

ROBERT W. SCHERY

Recent years have seen rapid advances in the use of various chemical substances as selective herbicides—valued for killing unwanted plants while being innocuous to desirable kinds. 2-4-D (2-4-dichlorophenoxyacetic acid, to use its jawbreaking complete moniker) and its derivatives, especially useful for control of broadleaf weeds in lawns while not injurious to grasses, have shown the most spectacular rise. 2-4-D has been discussed in print the country over; it has been used for everything from spraying wheat fields by airplane to controlling poison ivy and scrub shrubs by means of tank sprayer, and applying with small sprayer or sprinkler to kill weeds in the lawn. It is marketed as a liquid, powder and salve, under a tremendous variety of brand

names. So well known are the 2-4-D products that no further mention of them need be given here (for additional discussion one may refer to the June 1947 Garden BULLETIN, "The Fabulous 2-4-D").

Still other selective herbicides that have received more modest but none-the-less widespread attention include potassium cyanate, TCA (sodium trichloroacetate), dichloral urea, maleic hydrazide, phenyl mercuric acetate, and other preparations. Potassium cyanate, unless very carefully used, tends to "burn" or kill desirable plants (such as bluegrass in lawns), as well as weed plants (crabgrass, chickweed, Lamium, etc.). But it does give good kill, is readily water-soluble and hence easily made into spray, and contributes some fertility in that upon breakdown in the soil it releases both potassium and available nitrogen. Its use to rid an established mixed lawn of crabgrass is much more risky (from the standpoint of injuring desirable species) than is the use of the phenyl mercuric acetate. TCA is similarly risky in application, and, although selective in proper concentrations, is more often combined in herbicides meant to kill all vegetation (as along right-of-ways).

Dichloral urea and maleic hydrazide are still largely in the experimental stage, the former showing promise of preventing germination of certain seeds and the latter of selectively killing certain grasses and other weeds that are troublesome in strawberry and similar perennial beds. The remaining compound listed, phenyl mercuric acetate, will be discussed in more detail below, for I have had opportunity to test it at the Garden during the past summer as it is marketed in a dry state compounded with a special type of vermiculite and certain other ingredients*. Phenyl mercuric acetate is also reported available in solution form, and as such would have the advantage over the vermiculite compound in sticking more readily to the crabgrass foliage. It would then be somewhat less easily handled and spread, however, and the ever possible danger of a high concentration of "poison" would exist.

Rather simple tests at the Garden attempted to evaluate Scutl chiefly for: (1) its effectiveness in killing crabgrass, (2) lawn appearance after application, (3) toxicity to desirable plants, (4) convenience in handling and, (5) costliness of crabgrass removal by this means. Supplementary and confirming tests were conducted on two selected plots in St. Louis county, and efforts were made to consult a few home-owners of this area regarding their opinions following use of this herbicide. Unfortunately my tests do not embrace very early (June-July) treatment of the lawn, for the shipment of herbicide was not received until late July, by which time almost all lawns infested with crabgrass were near solid masses of this weed, the original seedlings

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* The trade name is Scutl: material for testing granted courtesy of O. M. Scott & Sons Co., Marysville, Ohio.

Fig. 1. Portion of test lawn strip treated in late summer with phenyl-mercuric herbicide. To left is complete crabgrass kill with several applications of Scutl; center shows yellowing crabgrass following a single double-strength application; to far right is crabgrass lawn untreated.

having spread radially to distances of as much as two feet by means of the characteristic rooting of runners. The coming summer will offer opportunity to test this herbicide more thoroughly on the early seedling stage of crabgrass, and a fuller evaluation should be possible next autumn.

It should be mentioned that on my test plots Scutl was applied by means of a Scott's spreader in regulated concentrations with a minimum of inconvenience. Hand broadcast or shaking from the carton is not as uniform or as satisfactory as is use of a spreader. The vermiculite base of this compound has a particle size about that of coarse sawdust, but is much lighter in weight. It is simply poured directly into the hopper of the spreader without need of measuring the quantity. A lever regulates the concentration that drops through the outlet, and what is not used can be returned to sack or carton. The numerical calibration of opening size on the spreader can easily be translated over to lbs./acre or cartons/1000 sq. ft. by reference to the manufacturer's data. Recommended single strength application is about one box (4 lbs.)/1250 sq. ft.

1. *Effectiveness.*—There is no doubt that, in general, Scutl can and will kill crabgrass, but predictable results were almost completely impossible for any given application or specific area in last year's tests. The product applied in identical concentrations to two adjacent plots, but with the applications a few days apart (and hence experiencing slightly different temperatures

Fig. 2. Strip to left has been treated with double dosage of phenylmercuric acetate to kill almost all crabgrass. The crabgrass to the right grows unchecked. Light splotches toward far end of treated strip are *Muhlenbergia Schreberi,* and a sprinkling of bluegrass shows through among the dead remains of crabgrass.

or other environmental conditions), might give perfect crabgrass kill in one case and almost none in the other. Results of a single application may thus be rated from "excellent" to "disappointing." Two or three applications at about one-week intervals are recommended by the manufacturer, and if the precautions mentioned below are taken, this is usually effective in ridding the lawn of most or all crabgrass. Action of the compound is slow and progressive, so that results may not be apparent until after a few weeks, when the brown and dried crabgrass is noticed. There is not the immediate kill characteristic of caustic herbicides, but rather the slower physiological disturbance characteristic of growth-regulating materials.

Since action of the herbicide depends upon absorption through the grass leaf, any measure which will insure even spread and sticking of the material over the greater part of the leaf surface will increase its effect. Very poor

crabgrass kill results when the material is applied under the following conditions: (1) just before rains (which wash it from the leaves); (2) under very dry conditions, especially when wind or movement about and behind the spreader is apt to dislodge the vermiculite from the grass leaves; or (3) when the grass is so high that the leaves are bent and shaken by the spreader as it passes over the lawn. Conversely, best crabgrass kill has resulted in my tests when Scutl is applied to freshly mowed lawns that are rather moist (preferably very early morning while dew or leaf guttation is evident, causing the vermiculite to stick), and when application is followed by a few days of clear warm weather. I am inclined to believe that crabgrass kill is better in warmer weather than in cool, and when the grass is vigorously growing (generally after rains) rather than when static (as during drought). Almost certainly other factors whose influence is not readily evident confuse the picture. Such considerations as general condition and age of the plants, soil status, possibly even sunlight and day length, may to greater or lesser extent influence effectiveness of the herbicide.

In any event, no matter the pains taken in application, one must be ready to expect anything from complete failure to complete success in crabgrass kill for any one application of a phenyl mercuric herbicide in the St. Louis area. In 1950 seemingly some peculiar combination of circumstances in late July and early August, perhaps the unexpectedly cool "summer resort" weather then prevailing, made crabgrass kill difficult. On the other hand, one double-strength application in late August gave practically 100 per cent kill on a test plot! In another instance reported to me, a single-strength application to a portion of a county lawn gave nearly perfect kill in midsummer, but repeated double-strength applications to adjacent areas slightly later had little effect. Then just a few days after these failures an identical dosage gave partial kill on an adjacent plot.

Part of the effectiveness of phenyl mercuric acetate has been reported to be lost when used in mixture with fertilizers. It is said, however, that it can be used in spray form with 2-4-D, and that, if anything, its effectiveness is then increased. One might wonder if it is desirable to subject growing plants to so much "medication" at one time, whether or not there is any antagonism. Mild dosages of phenyl mercuric acetate should have some fungicidal effect, and, in fact, the compound was originally investigated as a fungicide rather than herbicide.

2. *Lawn Appearance after Treatment.*—The close-mown but otherwise untended lawn often evident in the St. Louis summers, is almost solid crabgrass. Any residual bluegrass from spring growth becomes smothered with crabgrass by July and August, and normally approaches a state of near dormancy in the typically hot summer weather. In such cases one is faced

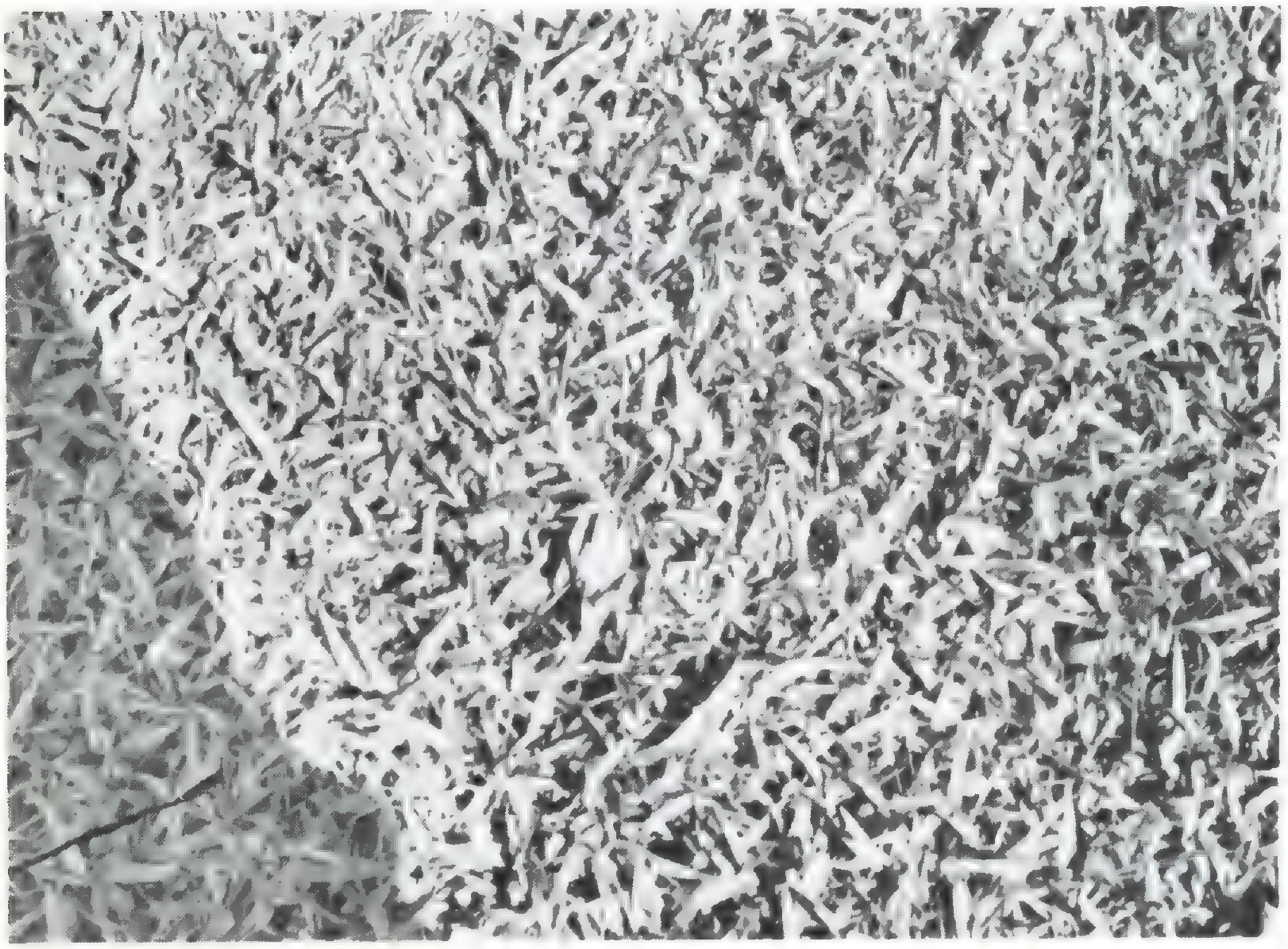


Fig. 3. Close-up of late summer crabgrass-infested portion of lawn untreated with herbicide. Note almost solid mass of crabgrass, bright green in color. Compare with fig. 4.

Fig. 4. Close-up of section of lawn in late summer, where crabgrass has just been killed with phenyl-mercuric acetate. Note withered brown remains of crabgrass and a few bluegrass plants showing through. Compare with fig. 3.

with the alternative of crabgrass or nothing, and unless an effort is being made to establish a lawn of more desirable species, herbicidal treatment would be wasted effort. Complaints have been reported of professional landscape men hired to eliminate crabgrass but in so doing have literally "killed everything" in the lawn to produce a brown eyesore not envisioned by the owner anticipating improvement in an acceptably green lawn.

The more usual lawn in the area, one that receives some modicum of attention other than mowing, contains a mixture of grasses and broad-leaf weeds (see March 1948 and June 1950 Garden BULLETINS). In this case there is excellent opportunity to favor the desirable species at the expense of crabgrass, with only a temporary or slight worsening in appearance of the turf. Application of a phenyl mercuric herbicide can rather gradually eliminate the crabgrass while allowing other grasses to more or less take over. Of course, there will be temporarily splotches of dead, brown crabgrass,—until, in the everlasting cycle of the seasons, bluegrass growth becomes vigorous in early autumn and produces a more lasting green which tends to fill the lawn through the winter.

A striking example of this can be seen in the test plot at the Garden (figs. 1–4). In August 1950 one half of the test area (then almost solidly covered with crabgrass) was treated with Scutl. This portion turned a rather unsightly brown, except for a little green relief from a thin scattering of certain more desirable species (Kentucky Bluegrass, *Poa pratensis,* and *Muhlenbergia schreberi;* later, Annual Bluegrass, *Poa annua*). The untreated control area remained a green carpet of crabgrass. Yet the vestiges of more desirable species in the treated area, uninhibited by smothering crabgrass, expanded, and by late September formed a fairly acceptable turf. This area remained green through most of the winter, while the untreated crabgrass area was a sea of brown after a killing frost. The thin scatterings of more desirable grasses there had had no opportunity for early autumn expansion. This spring the discrepancy in the two plots has been even more accentuated. Vigorous clumps of bluegrass (both *Poa annua* and *P. pratensis*) dominate and largely fill the area treated with Scutl last August, while the untreated portion has a meager sprinkling of much smaller, weaker bluegrass plants. I expect this difference will persist into summer, and there should then be far less crabgrass for the better grasses to compete with in the treated plot (since last year's crabgrass there was mostly killed before setting seed). By sacrificing appearance to some extent last August and early September, we have given bluegrass the upper hand and are reaping the benefit of many months of superior greenness. We have had a better lawn through late autumn, winter and spring, and the more desirable grasses are now in a position to compete more successfully with crabgrass in the future.

3. *Toxicity to Desirable Lawn Plants.*—I have already intimated that phenyl mercuric acetate appears to affect nothing but crabgrass. There is something about the physiology of crabgrass (Digitaria) that makes this genus susceptible to the chemical, while Poa, Muhlenbergia, Agrostis, Festuca, etc. seem to be in no way bothered by the concentration of phenyl mercuric acetate used in the commercial preparation. In the plots under observation I have not seen a single other kind of plant than Digitaria killed by the herbicide, including the common broad-leaved weeds (as dandelion, chickweed, henbit, *Polygonum aviculare,* and plantain) and the many familiar grasses. This is truly a remarkable case of selectivity indicating that the phenyl mercuric compounds can be used with far more safety about the home yard and garden than can most other selective herbicides on the order of 2-4-D. Certainly in this respect the phenyl mercuric compounds are superior to potassium cyanate as a crabgrass killer, since the latter invariably tends to brown other grasses as well. I have not tested high concentrations of phenyl mercuric acetate on lawn plants, but reportedly it would then have disadvantageous results, just as would almost any chemical in high concentration. The herbicidal effect and selectivity of phenyl mercuric acetate were entirely unexpected at the time of its "discovery." Dr. J. A. deFrance and his associates at Rhode Island State College noticed while testing mercuric compounds for disease control of grasses, that there occurred a deleterious effect upon crabgrass, but not other grasses. This was the clue ultimately leading to development of the phenyl mercuric acetate type of crabgrass killer.

4. *Convenience in Use.*—The safeness in handling of the phenyl mercuric compound makes it rather easily used. One need not fret about the wind carrying a spray dust to the rose bed, lethal residues remaining in spreader or sprayer, or the possibility of children and pets poisoning themselves with the product. In the vermiculite form the herbicide is easily and quickly handled, especially when applied with a spreader. I do feel, however, that some of its effectiveness is then lost, in that, compared to a spray solution, adherence to the crabgrass leaves becomes difficult (see section on "Effectiveness"). Then too, the vermiculite of Scutl is dyed a green color, presumably to match the turf. The dye is water soluble and is apt to discolor white shoes or clothing when the material is applied to dew-wet grass or otherwise comes in contact with moisture.

5. *Expense of Freeing the Lawn of Crabgrass.*—Perhaps the biggest barrier to more widespread utilization of the Scutl-type herbicide lies in the costliness of treatment. In crabgrass elimination it may or may not (if one

is especially lucky) be necessary to give a lawn repeated or double-strength treatments. Under "Effectiveness" it was pointed out that this possibility certainly cannot be disregarded, and the procedure recommended by the manufacturer is to use double or more the quantity of material perhaps anticipated (unless the home-owner recognizes at the start that any selective herbicide is seldom completely effective in a single application). Furthermore, to be effective in ridding a lawn of crabgrass, the whole lawn is best treated—otherwise local infestations of crabgrass not prevented from seeding can quickly spread. No matter the intrinsic merits of a lawn weeder, many potential users will think twice before spending several, perhaps many, dollars for the elimination of crabgrass in a St. Louis lawn of a few thousand or more square feet. Proven effectiveness and money-back guarantees may matter less to some home-owners than outlay of hard cash in a region where at its best the establishment of a good quality bluegrass lawn is difficult.

Summarization.—In summary one might state that the phenyl mercuric herbicides hold high new hope for the busy home-owner who has an interest in establishing or maintaining a good lawn. In the St. Louis area the user of such a herbicide can expect some disappointments due to uncertain causes, no matter how carefully the recommended procedures are followed. Tests at the Garden last summer indicate greatest effectiveness in applying Scutl in early morning on dew-wet, recently mowed grass, during favorable growing but not rainy weather. If one be in a position to use multiple applications, sooner or later the happy set of circumstances needed to effect complete crabgrass kill will materialize, and a much finer lawn should then result. Don't expect too sudden or striking results, however;—as the advertising states, the herbicidal action is "subtle." Certainly treatment with phenyl mercuric compounds offers a much quicker road to crabgrass-free lawns than does biological control (from letting crabgrass's natural competitors gradually over-run it—see discussions in Garden BULLETINS), and for this reason has much to recommend it. Whether or not crabgrass will develop strains immune to the herbicidal effect of phenyl mercuric acetate, only the future can tell.

CORRECTION: Mr. Brenner's attention has been called to an incorrect botanical name appearing in his article "Spontaneous Wild Flowers" in the March BULLETIN. The Wood Lily should have been listed as *Lilium michiganense* instead of *L. philadelphicum*. The latter is not found wild in Missouri, although its range may seem to include our state. Moreover, its erect bell-like flowers are quite different from the nodding flowers of our native *L. michiganense*.

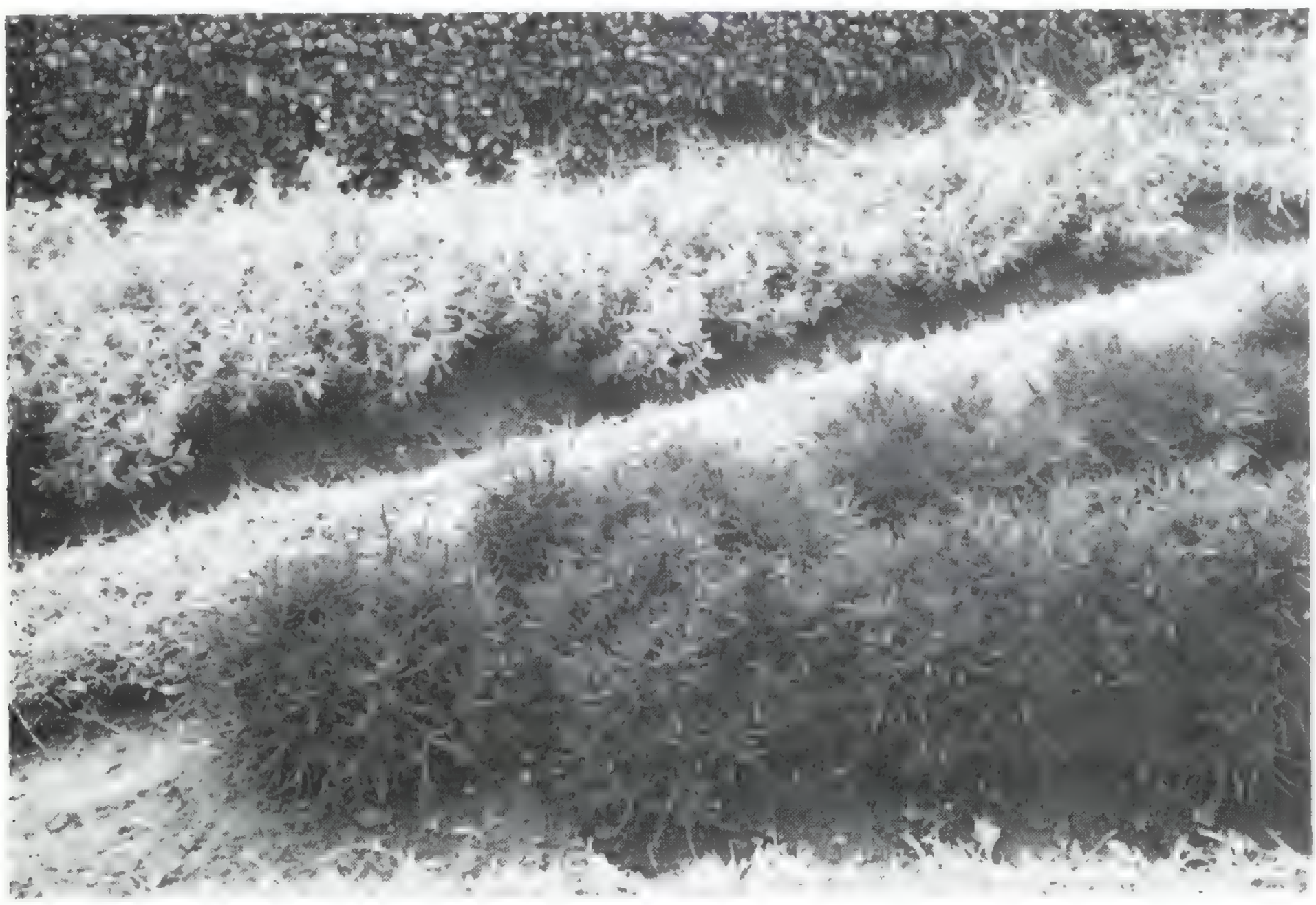
TWO GOOD SANTOLINAS

PAUL A. KOHL

Many bedding plants are grown in the formal garden, better known as the Italian Garden, and to maintain a constant color in each bed during the summer months, only foliage plants are used. Some of these plants are abutilons, acalyphas, alternantheras, coleus, crotons, echeverias, santolinas and others.

Lavender-cotton, *Santolina chamaecyparissus*, a plant native to the Mediterranean region, is unquestionably the best and neatest, silvery-gray plant for edging and bedding purposes. Individual plants are compact and are composed of many finely divided, woolly, gray leaves. It grows about twelve inches high, but by shearing it may be held to any height and width.

Some years ago we received a packet of seed labeled *Santolina alpina nana*. The plants grown from this seed were green, but in almost all other respects resembled the gray Santolina. Since then we have propagated it by cuttings and have used it extensively in beds and as a low hedge. When we were asked where this Santolina might be purchased we discovered that it was almost unobtainable. We also realized that the name under which it came to us was incorrect. In Bailey's 'Hortus Second' we read that "*Santolina alpina* is a confused name, the material in cultivation probably referable to *Anthemis montana*." In checking santolinas in old gardening literature in our library we found an article on *Santolina viridis* in the British publication,



Santolina chamaecyparissus (above), *Santolina virens* (below)

Santolina chamaecyparissus and *Santolina virens*

Gardening Illustrated (Vol. 36, page 25, January 10, 1914). This Santolina seemed to be the same one we are growing. Since Mr. Rex D. Pearce of Moorestown, New Jersey, who specializes in seeds of rare plants, listed *Santolina virens* in his catalogues, we compared our plant with his. They were alike, and Mr. Pearce informed us that while he originally listed the plant as *Santolina viridis*, it should be *Santolina virens*, as that name takes precedence over S. *viridis* according to Dr. George H. M. Lawrence of the Bailey Hortorium of Cornell University.

Both of these santolinas may be grown from seed, if it is obtainable. Our method of propagating them is to take cuttings in the fall and grow the plants in the greenhouse during the winter. Stock plants may also be lifted in the fall and held in a cold frame. When the winter is not too cold, these santolinas will survive and will grow again the following season. Perennial nurseries sell the gray-leaved santolina and it is hoped more of them will also stock *Santolina virens*, the green-leaved species.

Winter Injury.—Earlier this year it was feared that many shrubs of border-line hardiness would be winter-killed, because of the very sudden freeze following mild weather in November and the severe cold in midwinter following the mild weather of early January. It appears now that boxwood (*Buxus sempervirens*), *Abelia grandiflora*, most roses, *Pieris japonica* flowers, Pyracantha, less hardy strains of *Hedera helix* and a few hollies have suffered more or less injury, as have perhaps flower buds of some later-flowering

shrubs. But seldom have any of these plants been completely killed where well established. *Mahonia aquifolium*, Andorra Juniper, and certain other evergreens have shown unusually heavy sun-scald.

ST. LOUIS SPRINGTIMES

ROBERT W. SCHERY

Of perennial interest is the advent of spring. After the drabness of winter almost every one looks forward with eagerness to the greening of the bluegrass lawn, the saucy first daffodils often braving cold and sleet in March and early April, and the flowering of all the favorite shrubs, herbs and trees. In the April BULLETINS for the past five years I have kept tab on springtime's arrival in St. Louis, as expressed by the first flowering of certain species at the Garden. A compilation of the flowering record to 1950 was given last April in chart form, and the record is tabulated for 1951 (Table 1) up to the time this issue goes to press. It being obviously impractical after six years to list each year's blooming period separately, I have averaged the first flowering dates for all species listed, and in separate columns given the earliest and latest flowering date within the span of observation. The year 1951 can thus be readily compared with the "average" for the preceding five years (or less for certain species that have not been continuously available for observation).

Evidence continues to accumulate that of the years observed the spring of 1946 was inordinately early. On the basis of the record so far it appears that 1951 is becoming very "late." The year 1947 appears to have been one of the latest springs heretofore.

An enthusiastic and reliable gardener of University City, who prefers to remain anonymous, has kept blooming records from 1927 until 1942. In many cases (quite understandably), these have been rounded off to the nearest 5-day interval of blooming time. Epitomizations of selections from the more complete or interesting records from this notebook are given in Tables 2, 3, and 4. It will be noted that, in general, spring flowering dates in St. Louis during that decade were little different in either the absolute or early–late spread compared to what St. Louis has experienced since World War II. The earlier records further emphasize how very early was the spring of 1946 (Table 1); 1938 and perhaps 1929 were more or less comparable in the epoch of these observations. Even where 1938 was not the earliest date in the figures it generally ranked second. Apparently 1940 was one of the later springs on record, although late springs are never so markedly "late" as are early springs "early." If any conclusion can be drawn from this not inconsiderable data, it is that St. Louis gardeners should be ready to "expect anything" of their springtimes.

TABLE 1. RECORD OF FLOWERING DATES FOR SELECTED PLANTS, FROM 1946–1951

Plant	1951 first flowering date	Average first flowering date*	Number and span of years observed	Earliest flowering date	Latest flowering date
Snowdrop *(Galanthus nivalis)*	Jan. 20	Feb. 10†	5 ('46–'51)	Jan. 20, '51	Mar. 2, '48
Crocus, early yellow *(Crocus* sp.)	Feb. 2	Feb. 15	4 ('48–'51)	Late Jan., '50	Mar. 2, '48
Silver maple *(Acer saccharinum)*	Feb. 26	Feb. 22†	6 ('46–'51)	Late Jan., '50	Mar. 24, '47
Crocus, large blue *(Crocus* sp.)	Mar. 6	Mar. 6	4 ('48–'51)	Feb. 28, '50	Mar. 17, '48
Cornelian cherry *(Cornus mas)*	Mar. 6	Mar. 7†	6 ('46–'51)	Feb. 28, '46 & '50	Mar. 18, '47
Hazel, European *(Corylus avellana)*	Mar. 6	Mar. 7	5 ('47–'51)	Mar. 5, '49	Mar. 24, '47
Elms *(Ulmus* spp.)	Mar. 6	Mar. 8†	6 ('46–'51)	Feb. 18, '46	Mar. 24, '47
Fragrant honeysuckle *(Lonicera fragrantissima)*	Mar. 8	Mar. 9†	6 ('46–'51)	Feb. 28, '46 & '50	Mar. 24, '47
Goldenbell *(Forsythia* spp.)	Mar. 6	Mar. 13†	6 ('46–'51)	Mar. 4, '46	Apr. 2, '47
Chickweed *(Stellaria media)*	Mar. 6	Mar. 15†	6 ('46–'51)	Feb. 20, '50	Apr. 1, '47
Daffodils *(Narcissus* spp.)	Mar. 20	Mar. 22	5 ('47–'51)	Mar. 20, '51	Apr. 2, '47
Glory-of-the-snow *(Chionodoxa* spp.)	Mar. 16	Mar. 22	3 ('49–'51)	Mar. 16, '51	Mar. 26, '49
Japanese Andromeda *(Pieris japonica)*	Mar. 26	Mar. 23†	6 ('46–'51)	Mar. 18, '46 & '50	Apr. 1, '47
Shepherd's Purse *(Capsella bursapastoris)*	Mar. 26	Mar. 23	3 ('48–'50)	Mar. 22, '48	Mar. 29, '49
Magnolia, Star *(Magnolia stellata)*	Mar. 27	Mar. 24†	6 ('46–'51)	Mar. 5, '46	Apr. 7, '47
Periwinkle *(Vinca minor)*	Mar. 26	Mar. 25	3 ('49–'51)	Mar. 23, '50	Mar. 26, '51
Spice Bush *(Lindera aestivale)*	Mar. 27	Mar. 26	3 ('49–'51)	Mar. 25, '49	Mar. 27, '51
Magnolia, Saucer *(Magnolia soulangeana)*	Mar. 30	Mar. 26†	6 ('46–'51)	Mar. 5, '46	Apr. 7, '47
Plum *(Prunus* spp.)	Mar. 28	Mar. 27†	6 ('46–'51)	Mar. 4, '46	Apr. 7, '47
Sumac, Aromatic *(Rhus aromatica)*	Mar. 29	Mar. 28†	6 ('46–'51)	Mar. 21, '46	Apr. 7, '47
Grape Hyacinth *(Muscari* sp.)	Mar. 30	Mar. 30	4 ('48–'51)	Mar. 27, '50	Apr. 3, '48
Boxelder *(Acer negundo)*	Apr. 10	Mar. 29†	5 ('46–'50)	Mar. 8, '46	Apr. 10, '51
Cottonwood *(Populus deltoides)*	Apr. 17	Apr. 2	6 ('46–'51)	Mar. 21, '46	Apr. 7, '47
Henbit *(Lamium amplexicaule)*	Apr. 19 or later		2 ('49–'50)	Mar. 31, '50	Apr. '51
Ash *(Fraxinus* sp.)	Apr. 17	Apr. 3†	6 ('46–'51)	Mar. '18, '46	Apr. '51
Oregon Hollygrape *(Mahonia aquifolium)*	Apr. 19 or later	Apr. 6	3 ('49–'51)	Mar. 31, '50	Apr. 19, '51
Norway maple *(Acer platanoides)*	Apr. 17	Apr. 4†	6 ('46–'51)	Mar. 18, '46	Apr. 19, '51
Sassafras *(Sassafras albidum)*	Apr. 19 or later	Apr. 6	5 ('46–'50)	Mar. 18, '46	Apr. 21, '47
Redbud *(Cercis canadensis)*	Apr. 19 or later	Apr. 7	5 ('46–'50)	Mar. 6, '46	Apr. 25, '47
Purple Crabapple *(Malus purpurea)*	Apr. 14		1 ('50)	Apr. 9, '50	Apr. 14, '51
Wintergreen barberry *(Berberis julianae)*	Apr. 18		1 ('50)	Apr. 10, '50	Apr. 18, '51

TABLE 1 (Continued)

Plant	1951 first flowering date	Average first flowering date*	Number and span of years observed	Earliest flowering date	Latest flowering date
Currant, Golden *(Ribes aureum)*	Apr. 14	Apr. 13	4 ('47–'50)	Apr. 7, '48 & '49	Apr. 21, '47
Lilac, common *(Syringa vulgaris)*	Apr. 20 or later	Apr. 13†	5 ('46–'50)	Mar. 26, '46	Apr. 27, '47
Charles' Viburnum *(Viburnum carlesii)*	"	Apr. 16	3 ('48–'50)	Apr. 13, '48 & '49	Apr. 23, '50
Buckeye *(Aesculus* sp.*)*	"	Apr. 16†	5 ('46–'50)	Mar. 27, '46	Apr. 27, '47
Storax *(Styrax* sp.*)*	"	Apr. 17†	4 ('46–'49)	Mar. 27, '46	May 4, '47
Oaks, various *(Quercus* spp.*)*	"	Apr. 17†	5 ('46–'50)	Apr. 1, '46	Apr. 27, '47
Willow, Black *(Salix nigra)*	"	Apr. 18†	5 ('46–'50)	Apr. 5, '46	Apr. 29, '47
Birch, European *(Betula pendula)*	"	Apr. 18	4 ('47–'50)	Apr. 9, '48	Apr. 25, '50
Hackberry *(Celtis occidentalis)*	"	Apr. 18†	4 ('46–'50)	Mar. 24, '46	Apr. 30, '47
Pea-shrub *(Caragana arborescens)*	"	Apr. 19	3 ('48–'50)	Apr. 13, '48	Apr. 23, '50
Xanthoceras *(Xanthoceras sorbifolia)*	"	Apr. 19	3 ('48–'50)	Apr. 13, '48	Apr. 24, '50
Silverbell *(Halesia carolina)*	"	Apr. 19†	5 ('46–'50)	Mar. 30, '46	May 3, '47
Sweetgum *(Liquidambar styraciflua)*	"	Apr. 19†	5 ('46–'50)	Mar. 30, '46	May 2, '47
Hawthorn *(Crataegus* sp.*)*	"	Apr. 21	4 ('47–'50)	Apr. 15, '48 & '49	May 1, '47
Swamp Privet *(Forestiera acuminata)*	"	Apr. 21	4 ('47–'50)	Apr. 16, '49	Apr. 29, '47
Mulberry *(Morus* sp.*)*	"	Apr. 21†	5 ('46–'50)	Apr. 2, '46	May 1, '47
Bluegrass, Kentucky *(Poa pratensis)*	"	Apr. 21†	5 ('46–'50)	Apr. 5, '46	Apr. 28, '47
Fleabane *(Erigeron* sp.*)*	"	Apr. 26†	5 ('46–'50)	Apr. 20, '46 & '48	May 4, '47
Paper Mulberry *(Broussonetia papyrifera)*	"	May 1	4 ('47–'50)	Apr. 25, '48 & '49	May 12, '50
Locust, Kelsey *(Robinia kelsey)*		May 1†	5 ('46–'50)	Apr. 15, '46	May 13, '47

* Given only when observed three or more years.

† Where 1946 observations are available and included, average will be "abnormally" a bit earlier.

TABLE 2. COMPILATION OF FLOWERING DATES FROM 1927 TO 1941

Plant	Number of years observed and span	Earliest flowering date	Latest flowering date	Average flowering date
Amygdalus (Prunus sp.), Flowering almond	12 ('27–'40)	Mar. 30, '38	Apr. 22, '37	Apr. 15
Aronia melanocarpa	13 ('27–'40)	Mar. 20, '38	Apr. 15, '28	Apr. 4
Cornus mas, Cornelian cherry	5 ('37–'41)	Mar. 5, '38	Apr. 1, '37, '40 & '41	Mar. 25
Cornus aurea?, Dogwood?	7 ('33–'39)	May 15, '38	May 30, '35	May 23
Cotoneaster acutifolia, Peking Cotoneaster	7 ('28–'37)	Apr. 20, '37	May 10, '28, '29 & '31	May 5
Chionanthus, Fringe Tree	3 ('39–'41)	May 8, '41	May 20, '40	May 14
Deutzia gracilis; buds winter killed and no bloom '27, '30, '31, '35, '36, '38	8 ('27–'40)	Apr. 15, '28	May 20, '40	May 11
Deutzia lemoinei	12 ('28–'41)	Apr. 25, '29	May 15, '28, & '40	May 6
Euonymus alatus, Winged Wahoo	6 ('33–'38)	Apr. 25, '38	May 10, '35, '36 & '37	May 6
Exochorda grandiflora, Pearl-bush	13 ('27–'40)	Apr. 10, '29	May 2, '40	Apr. 24
Forsythia spectabilis	5 ('37–'41)	Mar. 10, '38	Apr. 8, '41	Mar. 29
Hydrangea arborescens	7 ('28–'39)	June 5, '33 & '39	June 15, '28, '29, '32 & '35	June 11
Kerria japonica	13 ('27–'41)	Apr. 10, '29	May 5, '31, '34, '36 & '39	Apr. 27
Kolkwitzia amabilis, Beauty-bush	8 ('33–'41)	May 1, '38	May 15, '35	May 8
Lonicera fragrantissima, Fragrant Honeysuckle	9 ('32–'40)	Feb. 14, '38	Apr. 25, '36	Mar. 21
Magnolia soulangeana, Saucer Magnolia	5 ('37–'41)	Mar. 15, '37	Apr. 11, '41	Mar. 26
Malus ioensis bechteli, Bechtel's Flowering Crab	9 ('33–'41)	Apr. 15, '38	May 5, '37, '39 & '40	Apr. 30
Philadelphus coronarius, Mock-orange	15 ('27–'41)	May 2, '38	May 30, '40	May 18
Philadelphus grandiflorus, Mock-orange	15 ('27–'41)	May 15, '38	June 1, '28, '31 & '37	May 26
Spiraea arguta	15 ('27–'41)	Mar. 20, '38	Apr. 15, '27	Apr. 5
Spiraea vanhouttei, Van Houtte's Spirea	15 ('27–'41)	Apr. 20, '38	May 10, '28, '35, '37, '40	May 4
Syringa vulgaris	11 ('27–'40)	Apr. 10, '29 & '30	May 1, '37, '39, '40	Apr. 23
Viburnum carlesii	8 ('34–'41)	Mar. 15, '35	Apr. 20, '39, '40	Apr. 2
Viburnum opulus, Highbush Cranberry	15 ('27–'41)	May 1, '38	May 25, '30	May 13
Weigela rosea	15 ('27–'41)	May 1, '38	May 15, '28, '31, '32, '35, '37, '40	May 10

TABLE 3. ORDER OF BLOOM FOR 1941 AND 1942

Plant	1941 First flowering date	1942 First flowering date
Cornelian Cherry *(Cornus mas)*	April 1	March 20
Fragrant Honeysuckle *(Lonicera fragrantissima)*	April 5	March 20
Japanese Andromeda *(Pieris japonica)*	April 5	March 20
Forsythia sp.	April 8–10	March 20
Saucer Magnolia *(Magnolia soulangeana)*	April 11	March 25
Spiraea arguta—east of house	April 12	April 1
Spiraea arguta—west of house	April 15	April 1
Charles' Viburnum *(Viburnum carlesii)*	April 16	April 17
Dwarf Iris—east of house	April 18	April 1
Crabapple *(Malus atrosanguinea)*	April 20	April 10
Crabapple *(Malus floribunda)*	April 20	April 15
Flowering Almond *(Amygdalus* sp.)	April 20	April 10
French Lilac *(Lonicera* sp.)	April 21	April 17
Pearl Bush *(Exochorda grandiflora)*		April 18
Magnolia *(Magnolia nigra)*	April 25	
Hawthorn *(Crataegus* sp.)	April 25	April 19
Deutzia lemoinei	May 1	April 26
Aronia *(Aronia* sp.)	May 1	April 30
Bechtel's Crab *(Malus ioensis* var. *bechteli)*	May 1	April 25
Spiraea vanhouttei	May 5	April 28
Deutzia gracilis	May 5	April 30
Spiraea reevesianum		April 29
Weigelia *(Weigela rosea)*	May 5	April 30
Beauty Bush *(Kolkwitzia* sp.)	May 5	May 1
Snowball *(Viburnum opulus sterilis)*	May 5	May 1
Highbush Cranberry *(Viburnum opulus)*	May 8	May 1
Fringe Tree *(Chionanthus* sp.)	May 8	May 3
Mock-orange *(Philadelphus polyanthus)*	May 15	May 5
Mock-orange *(Philadelphus coronarius)*	May 20	May 10
Ninebark *(Physocarpus* sp.)		May 10
Mock-orange *(Philadelphus lemoinei)*		May 15
Mock-orange *(Philadelphus virginalis)*		May 22
Mock-orange *(Philadelphus grandiflorus)*		May 25

TABLE 4. WEATHER FROM 1931 TO 1944

1931	Abundant bloom after 1930 drouth.
1931–1932	Winter very mild with only a few days of cold weather. Some buds and a few flowers came out in November. Temperature 82° F. on Feb. 10, 1932, and 6° during last week in March.
1933	Late spring, cold and wet to May 15.
1934	Winter very mild and long. March very cold with snow. May very hot. Temperature first 10 days of month was 85–90°, and flowers wilted quickly.
1934–1935	Winter rather mild, with plenty of rain and little snow. Spring of 1935 cold and rainy—April 15 was 32°.
1936	Spring very cold. April 2 temperature was 22° F.; early bloom badly damaged. Severe drouth during June, July, and August. Winter very cold, nearly 30 days of zero weather.

1937	Spring very cold and wet up to May 5.
1937–1938	Very mild winter. Temperature 76° on Feb. 12, 1938. On March 21, temperature was 82°, and early shrubs were coming out. On April 3, temperature was 30°, causing some damage to tender plants. On April 8 there was ½ inch of snow and freezing weather (30°). Very wet season; heavy rains up to May 15.
1939	Cold April, with little in bloom, except Flowering Crab, up to April 25.
1940	January very cold, down to 10° below, and snow on ground from December 23 to March 1. Spring very raw and cold. On April 1, temperature was 82°, and on April 11, 24°. Some Spiraea and Deutzia buds killed by light frost on May 4, but no serious damage.
1940–1941	Winter very mild, only 2½ inches of snow. Some shrubs showed green February 15. March cold and raw. Spring 1941 best year ever known for bloom. All shrubs were covered with flowers.
1941–1942	Lots of rain in October, November, December; January dry. Only 4 or 5 days cold weather, not over 5° below. On Jan. 25 heard meadowlarks and found daffodils coming up.
1943	Worst spring ever. Zero weather first week in March killed most of the flower buds. All bloom except snowballs was very poor. Frost on April 21 and 22 killed peony buds, and Deutzia. Thermometer went down to 28°.
1944	Worst flood in April since 1844—6 inches of rain in 24 hours. Frost first week in May, second week 90°. June hottest since 1875. Some damage to tender plants April 8; ½ inch snow and freezing weather 30°. Very wet season. Heavy rain to May 15.

NOTES

Among the recent visitors to the Garden were: M. Maurice Lecoufle, of the orchid establishment Vacherot-Lecoufle, Boissy-Saint-Léger (S. & O.), France; Dr. G. W. Prescott, of Michigan State College, East Lansing; Dr. E. R. Spencer, soil expert, of Lebanon, Ill.; Mr. Rolland Stevens, Librarian, Ohio State University, Columbus Ohio.

Dr. Edgar Anderson, Geneticist to the Garden, has been appointed a member of the committee of the Division of Biology and Agriculture of the National Research Council, having as objective the preservation of indigenous strains of maize. The committee will coordinate its activities with those already under way, under the sponsorship of the Rockefeller Foundation in Mexico.

During the college Easter vacation, Dr. R. W. Schery, Research Associate, and Mr. Robert Nevins, graduate student, accompanied Dr. G. W. Prescott, of Michigan State College, on a trip through the Ozarks. The trip was designed to select the route for the botanical foray of the Central States Section of the Botanical Society of America which is planned for June. Serving on the local committee are Dr. Robert W. Schery, Chairman, Dr. Rolla M. Tryon and Mr. Hugh H. Iltis, all of the Garden.

THE MISSOURI BOTANICAL GARDEN

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SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 50,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

MISSOURI BOTANICAL GARDEN BULLETIN

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Cover: View in Great Smoky Mountains, home of the Silver-bell Tree.
Photograph by Paul A. Kohl.

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Missouri Botanical Garden Bulletin

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SHRUBS FOR SHADY PLACES

ROBERT W. SCHERY AND GUSTAV A. L. MEHLQUIST

PART I

The majority of shrubs probably appear at their finest—that is, with compact, symmetrical outline, full foliage, abundant flower and fruit—only when grown uncrowded in full or nearly full sun. Yet many are tolerant of a moderate amount of shading, and some do just as well in partial shade. A few shrubs are even shade lovers, growing best in open shade under a canopy of high-crowned trees or in northern and eastern exposures where they rely chiefly on reflected light. Quite obviously there is no hard-and-fast demarcation between shade shrubs and sun shrubs. Some familiar hardy types, such as Tatarian Honeysuckle *(Lonicera tatarica)*, various Viburnums, Privets (Ligustrum), the common Golden-bell (Forsythia), and Van Houtte Spirea *(Spiraea vanhouttei)*, may be planted in either situation.[1] These old favorites are among the most adaptable for the average home, and their frequent use is well deserved. In Part II of this article attention is more specifically called to a triumvirate of shrubs for shady situations that have proven to do well in the St. Louis area, but which none-the-less are comparatively little known and not used as much as they might be.

To realize the indistinctness of the boundary between shade- and sun-shrubs one need only turn to a few of the many books written by the experts on shrubs. A few genera and species, such as the Five-leaf Aralia *(Acanthopanax sieboldianus)*, Inkberry *(Ilex glabra)*, various privets *(Ligustrum* spp.*)*, the Rhododendrons, Arrow-wood *(Viburnum dentatum)*, and a few other kinds are almost invariably listed as desirable for shady places. But beyond these there is scant agreement. Almost every author recommends a few species not even mentioned by the other authors, and little consideration is ordinarily given to our native woodland understory shrubs or small trees. On the following pages we have assembled a list of shade shrubs recom-

[1] The best flowering development of these plants, however, is attained when they are grown in the sun.

mended by four different authorities (Free, Hottes, Van de Boe, and Wyman), added one or two species of our own choosing, and given a brief description and desirable qualities of most of them.

In an urban and suburban area few are the home-owners who would care to do without abundant shade from a variety of trees, but at the same time few are the properties large enough to permit both shade trees and areas of nearly full sun suitable for shrubs. There is definitely a need in the small home yard for shrub types that can thrive in at least partial shade, just as there is need of adequate shade in a typically hot St. Louis summer. A garden should have its shady spots, to keep soil temperatures down, to provide contrast and change of mood, and just plainly to permit enjoyment of midwestern summer afternoons under an overshadowing canopy of elm or oak.

Abelia grandiflora, Glossy Abelia.—

About 4 feet high, with graceful oval outline; semi-evergreen with shiny, dark green leaves that blend well with other foliage; paired pinkish flowers abundant most of the summer (especially July and August). Foundation planting and borders; sometimes winter-kills in St. Louis but usually only when young; moderately tolerant of shade, but does well in full sun.

Acanthopanax sieboldianus, Five-leaf Aralia.—

See discussion in Part II.

Acer palmatum, in variety, Japanese Maples.—

Small shrub-like trees; good autumn foliage (yellow to crimson); var.

Abelia grandiflora

dissectum has thread-like leaves. Background planting; many species of Acer are shade-tolerant (Striped Maple or Moosewood, the native *A. pennsylvanicum;* forest seedlings of Sugar Maple, *A. saccharum,* etc.), but most species develop best in the sun.

Aesculus parviflora, Dwarf or Bottlebrush Buckeye.—

See discussion in Part II. Several other species of Aesculus also do reasonably well in partial shade. Best known is perhaps *A. pavia,* the Red Buckeye.

Amelanchier canadensis, Shadbush or Service-berry.—

Small vase-shaped native tree, to 20 feet; leaves light green; abundant white flowers in early spring, before dogwood; edible purplish fruit in late spring or early summer. Naturalized and distant or background planting; tolerant of shade but does well in sun.

Aronia arbutifolia, Red Chokeberry.—

Erect shrub to 8 feet, oval in outline; smallish elliptical leaves, brilliant red in autumn; small flowers in May and persistent red fruit in autumn. Naturalized areas and distant planting; prefers moist subacid soil and tolerant of either shade or sun.

Azalea[1], in many species (including *A. amoena; A. mollis,* Chinese Azalea; *A. nudiflora,* Pinxter Azalea).—

Irregular, often spreading, to 8 feet; foliage usually blends well; noted for colorful display in spring; requires some special care (acid soil, heavy mulch, abundant water). Generally demands at least partial shade.

Berberis thunbergii, Japanese Barberry.—

Broadly oval, to 5 feet; common in both green- and purple-leaved varieties (*atropurpurea, minor, erecta* are all good). Versatile (for hedges, foundation planting, specimen shrubs). Good for autumn coloration, winter fruit, and for blending value; at its best when grown in the sun but will tolerate shade.

Buxus sempervirens and *B. microphylla* in many varieties, Boxwood.—

Large to dwarf, oval in outline; excellent evergreen foliage; slow-growing and generally difficult to establish; shears well; many strains scald or winter-kill in sun (not *B. microphylla koreana*). Specimen plants.

Calycanthus floridus, Sweet-shrub.—

Coarse straggling, oval, to 6 feet; fragrant flowers in early summer. Large, mixed shrub borders; prefers semi-shade.

Cephalanthus occidentalis, Button-bush.—

Native, oval, to 6 feet; large, shiny, whorled leaves; coarse, round flower-heads in summer. Specimen or distant planting; in shade or sun.

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[1] Most botanists place this genus under Rhododendron. In this article Azalea is used for the deciduous species, Rhododendron for the evergreen.

Berberis thunbergii (Japanese Barberry) grown in shade at Garden

Cercis canadensis, Redbud.—

Native tree, to 20 feet; heart-shaped leaves; beautiful spring flowers on twigs before leaves. Specimen plants or naturalized borders. Tolerant of shade but does better in sun.

Chaenomeles lagenaria (Cydonia japonica), Flowering Quince.—

Irregular, to 8 feet; attractive spring flowers. Familiar, versatile, multipurpose shrub; prefers sun but tolerates shade.

Chionanthus virginicus, Fringe Tree.—

Large shrub or small tree, oval, to 20 feet; foliage moderately coarse; delicate, fragrant spring flowers. Accent and specimen shrub; endures semishade well.

Clethra alnifolia, Sweet Pepperbush, Summer-Sweet.—See Part II.

Cornus (*C. alba*, Tatarian Dogwood; *C. alternifolia; C. florida*, Flowering Dogwood; *C. mas*, Cornelian Cherry; *C. racemosa*, Gray Dogwood).—

Shrubs to small trees; foliage attractive with arcuate venation; other desirable characteristics, as flower (early spring: *C. florida* and *C. mas;* others later into summer), colorful fruit, twigs or autumn coloration. Versatile; accent or specimen shrubs, distant borders, and naturalized plantings; shade-tolerant (*C. mas* especially) but does well in sun.

Corylopsis pauciflora, Winter Hazel.—

Oval, to 6 feet; yellow, early spring flowers. Specimen shrub; shade-enduring according to Hottes.

Dirca palustris, Leatherwood.—

Native, rounded, to 4 feet; smallish blossoms in early spring; curious socket-jointed twigs; good foliage. Prefers shade and moist soils.

Flowering Dogwood *(Cornus florida)* as a cultivated tree

Evonymus fortunei, E. alata, and *E. kiautschovica* (or *E. patens* in the trade), Wintercreeper, Winged Evonymus, Winterberry.—

Ground cover to erect oval shrub; of all-round excellence, attractive in fruit and foliage; *E. fortunei* (in var.) used as ground cover and climber; *E. alata,* a good specimen or accent shrub; *E. kiautschovica,* a medium-sized, evergreen shrub excellent as accent specimen; all shade-tolerant.

Forsythia spp., Golden-bell.—

Common, wide-spreading, to 8 feet; abundant golden flowers in very early spring. Distant borders and specimen shrub; tolerates shade but perhaps blooms more profusely in sun.

Hamamelis spp., Witch-hazel.—

Native and exotic, erect, irregular, to 12 feet; moderately large leaves that blend well. In the wild a woodland stream-border small tree; large borders and backgrounds; tolerant of shade and sun and city conditions.

Hydrangea arborescens, in var., *Snowhill Hydrangea; H. quercifolia; H. macrophylla (hortensis)*, in selected winter-hardy forms.—

Erect, commonly 4–8 feet; coarse, loose foliage; full clusters of summer flowers, the outermost generally sterile. Background specimen or accent shrub or tall hedge. Prefers light shade and ample water.

Ilex cornuta, Chinese Holly; *I. crenata*, Japanese Holly; *I. decidua*, Deciduous Holly; *I. glabra*, Inkberry; *I. opaca*, American Holly.—

Intermediate shrub to small tree; excellent foliage, evergreen except *I. decidua* and its relatives; summer bloom insignificant; often good winter fruit. Specimen and background plant, naturalized plantings, woods borders; usually prefers partial shade and ample moisture; in any case tolerant of shade.

Juniperus communis, Common Juniper.—

Irregular-spreading, to 4 feet, evergreen; blue "berries". Low massive or foundation planting; one of the few junipers that is shade-tolerant; does well only in dryish soil.

Kalmia latifolia, Mountain Laurel.—

Broad oval, to 8 feet; evergreen, esteemed for foliage and flower. Relative of Azalea and subject to same uses, needs, and difficulties.

Leucothoë catesbaei, Drooping Leucothoë.—

Spreading, to 4 feet. Splendid undergrowth plant among Rhododendrons or with conifers; subject to same needs and difficulties as Azaleas.

Ligustrum spp., Privet.—

Oval-erect to irregular, to 10 feet; good foliage, blends well; smallish flowers. Familiar, versatile, all-round shrub for everything from hedges and background planting to specimen shrubs. *L. ibolium*, a hybrid between *L. ibota* and *L. ovalifolium*, combines the best features of both parents; does well in the shade but at its best in the sun.

Lindera benzoin, Spice-bush.—

Native, small tree, to 12 feet; moderately attractive foliage, aromatic, golden in autumn, of some blending value; small yellow flowers before the leaves. Background planting; prefers moist soils; shade or sun.

Lonicera spp. (especially *L. tatarica*, Tatarian Honeysuckle; *L. morrowi*).—

Upright, to 8 feet; dull green foliage, blends well; smallish flowers in early summer; attractive late-summer fruit. Specimen and large border

shrubs; tolerates shade but does better in the sun.

Mahonia aquifolium, Oregon Holly-grape.—

Irregular-oval, to 5 feet; evergreen, "holly-like" foliage excellent in winter and summer; yellow flowers in spring; bluish fruits. Versatile; foundation planting to accent plant; prefers partial shade to prevent winter scald.

Myrica carolinensis, Northern Bayberry; *M. cerifera*, Wax-myrtle; *M. gale*, Sweet Gale.—

Oval, to 9 feet; foliage coarse but branching habit interesting, semi-evergreen; fruit grayish, waxy; typically a shore shrub but blends well with Rhododendrons. Sun or moderate shade.

Pachysandra terminalis, Japanese Spurge.—

Dwarf plant hardly to be classed as a shrub; coarse. A good shade ground cover.

Philadelphus coronarius, Fragrant Mock-orange.—

Bushy, to 10 feet; moderately coarse foliage; fragrant white flowers in early summer. In shrub groups, usually near habitation for flowers and fragrance; tolerant of shade, but, as with other mock-oranges, does better in the sun.

Pieris floribunda and *P. japonica*, Mountain and Japanese Andromedas.—

Compact, oval, to 5 feet; excellent, glossy, evergreen foliage; attractive slender clusters of cream-colored flowers. Relative of and treated like Azaleas; excellent foreground shrub.

Ptelea trifoliata, Hop-tree or Wafer-ash.—

Native, small tree, to 10 feet; coarse, aromatic, 3-foliolate leaves; winged green fruits. Naturalized plantings and distant borders; prefers light shade.

Rhamnus cathartica and *R. virginica*, Buckthorns.—

Small trees, to 12 feet; foliage rather coarse but blends well. Large shrub borders, backgrounds, and hedges. Tolerant of shade or sun.

Rhododendron album elegans; R. catawbiense, Catawba Rhododendron; *R. carolinianum*, Carolina Rhododendron; *R. maximum*, Rose Bay.—

Large (to 6 feet), round, "aristocratic", evergreen relatives of the Azalea; coarse but good foliage; handsome flowers. Splendid in woods planting; subject to Azalea requirements; prefers shade.

Rhodotypos scandens, Jetbead.—

Erect, to 6 feet; coarse, loose foliage; sparse white flowers in summer; black, persistent fruit. Versatile; foundation planting to shrub-bed filler; tolerant of shade, but (perhaps) develops better appearance in sun.

Rhus aromatica, Fragrant Sumac.—

Native, irregular, to 4 feet; coarse, aromatic, 3-foliolate leaves; clusters of small yellow flowers in spring. Low effects and tie-in with larger shrubs; shade or sun.

Ribes alpinum, Mountain Currant.—

Irregular-spreading, to 6 feet; attractive 3-lobed leaves; host to white-pine blister rust. Mostly used as hedge plant; perhaps grows fuller in sun but tolerant of shade.

Sambucus canadensis, Elder.—

Native, vase-shaped, to 10 feet; large, coarse, compound leaves; attractive white flowers and purple fruit in late summer. Distant borders or hedgerows; does best in sun but tolerant of shade.

Sorbaria sorbifolia, False Spirea.—

Vase-shaped, to 6 feet; large but finely cut pinnate leaves; large clusters of white flowers in early summer; suckers readily so tends to form clumps. Large shrub borders; prefers light shade.

Stephanandra incisa, Cutleaf Stephanandra.—

Spreading, to 4 feet; light green, delicate foliage that blends well; large clusters of small white flowers. Foreground and tie-in shrubs; prefers ample moisture; tolerant of shade.

Symphoricarpus albus and S. *orbiculatus*, Snow-berry and Coral-berry.—

Irregular, to 6 feet; untidy foliage; inconspicuous flowers; attractive fruits. Distant borders and slopes. Very tolerant of shade.

Taxus spp. (*T. cuspidata*, Japanese Yew, and its hybrids; *T. media*).—

Spreading to erect, to 5 feet; excellent glossy, evergreen needles; red seeds. Foundation planting and borders; one of the best shade-tolerant conifers.

Thuja occidentalis in many varieties, Arbor-vitae.—

Small erect trees; attractive "fronds" of light green to golden-green scale-needles. Moderantly tolerant of shade but not long lasting in the St. Louis area, becoming ragged in age.

Tsuga canadensis and *T. caroliniana*, Hemlock.—

Small to large forest trees; attractive flattened branchlets with dull green needles. Ordinarily becomes too large for foundation planting, otherwise one of the best conifers for shade; enjoys cool moist conditions.

Viburnum (*V. acerifolium*; *V. alnifolia*, Hobble-bush; *V. dentatum*, Arrow-wood; *V. lantana*, Wayfaring Tree; *V. Lentago*, Nanny-berry; *V. opulus*, High-bush Cranberry; *V. molle*, Kentucky Viburnum; *V. prunifolium*, Black-haw; *V. sieboldi*; *V. tinus*, Laurustinus; *V. suspensum*, Sandankwa Viburnum).—

A very diverse and useful genus; usually large shrubs; many shapes and shades of moderately coarse foliage that usually blends well, in a few cases semi-evergreen; attractive flower clusters in spring and summer; fruits usually ornamental. Accent and specimen shrubs; the species listed tolerate shade and some even prefer it. The "Snowball" Viburnums (*V. opulus roseum*, *V. tomentosum* vars. *sterile* and *plicatum*) also tolerate shade but do not produce as attractive or as profuse "snowballs" as when planted in the open.

Part II

THREE LITTLE-USED SHADE SHRUBS FOR THE ST. LOUIS AREA

Acanthopanax sieboldianus, Five-leaf Aralia.—

This excellent foliage shrub was introduced from Japan in 1859, and has in almost a century become widely although not heavily utilized for a variety of purposes in this country. Left to grow without trimming, it is a graceful, spreading, vase-shaped shrub from 5 to 10 feet tall, most useful

Leafy branch of *Acanthopanax sieboldianus*

for foundation planting, screens or barriers, and in mixed shrub borders. Its outstanding feature is its dense, neutral, palmate (5–7 leaflets) foliage of excellent blending value. It is very tolerant of adverse or city conditions, smoke, drought, winter cold, and harsh pruning. It seems to prefer a heavy soil, although tolerant of a light one, and is little bothered by insect pests or disease. The species suckers freely, and is easily propagated by root cuttings.

Leaves clothe the arching branches from base of the shrub to twig tip, forming a dense screen from soil level upward. Short stipule-like spines at the base of the alternate leaves serve as an effective armament, making

the shrub relatively impenetrable to larger animals. The petiole is 3–8 cm. long and more or less glabrous. The glossy leaflets are inverted egg-shape, about 3 cm. long, with toothed margins. Leaves turn a rather dingy yellow in autumn. Flowers are individually insignificant, greenish-white, but are borne in interesting umbels (stalked flowers all arising from one point in a ball-like cluster). They appear in early summer, and are unisexual (it is said that stock in cultivation has all been propagated vegetatively from a female or pistillate source plant). Characteristic of the order to which Acanthopanax belongs, the Umbelliflorae, is the inferior ovary in the small flower. This species can be highly recommended where effective screening is desired in a moderately large shrub.

Aesculus parviflora, Dwarf or Bottlebrush Buckeye.—

In the Bottlebrush Buckeye we have an excellent low shade plant very little used in this area. Perhaps its infrequent cultivation results from the large, coarse foliage and tendency to spread, making its effective use difficult in the small place. Prostrate branches seem to root readily (natural layering), so that large clumps of Bottlebrush Buckeye often 20 feet long while only about 5 feet high result. Therefore the species can be used most advantageously as a specimen group or background, much as it might occur in the wild in its native southeastern United States. The species does best in rich damp soil, but will maintain itself satisfactorily with almost no attention. It is most easily propagated by layering.

Aesculus parviflora growing at the Garden

As can be seen in the accompanying illustration, the plants remain leafy almost to ground level. The compound leaves are long-petioled (up to 15 cm. long or longer), with usually 5 palmate, short-petiolulate leaflets. These are mostly broadest above the middle, very finely toothed on the margins, smooth above, but finely haired and lighter green below where the prominent veins form a conspicuous network pattern. The greatest charm in the shrub comes from the late June flowers which are borne in tall terminal spires about 30 cm. long. Such narrow panicles bear 2–3 flowers on each secondary branch. The calyx is tubular, about 5 mm. long, from which protrude 4 slender white petals about 15 mm. long but only 3 mm. wide. Five or six delicate stamens (3 cm. long) extend well beyond the petals and bear at the tips reddish anthers contrasting with the white or cream flowers. Where sufficient space is at hand Bottlebrush Buckeye clumps can be highly recommended to add summer grace to shady spots and lawn vistas.

Flowers of *Aesculus parviflora*

Flowering branch of *Clethra alnifolia*

Clethra alnifolia, Summer-sweet or Sweet Pepperbush.—

This interesting summer-blooming shrub, native to low ground, moist stream banks, and marshy spots from Canada to Florida and Louisiana, has ornamental possibilities as a shade plant little exploited in the St. Louis area. Not only does it bear profuse racemes of 30 or more flowers in late July and August, but these are exceedingly fragrant. The twigs and foliage too are spicy aromatic. Plants will do well for years with a minimum of attention,

but do prefer rather moist, mildly acid soils. Summer-sweet forms an effective understory no more than 8 feet tall under the oak canopy abundant in this area. The species can be best used to line lowland paths or boundaries, or in naturalized plantings.

The alternate leaves are inverted lance-shaped, about 8 cm. long, more or less smooth, toothed on the margins, with 8–9 pairs of pinnate veins and no stipules. Twigs of the new growth have a slightly pinkish cast. The flower cluster much resembles that of an (erect) Japanese Andromeda, since after pollination the 5 white petals bend inward, almost closing over the reproductive parts. The petals are about 6 mm. long, notched at the tip. A stamen is attached at the base of each, between which 5 additional slightly larger stamens about 7 mm. long alternate. The anthers are expanded apically and open initially by pores. The style is 7–8 mm. long, 3-parted for the terminal 1 mm. All in all Summersweet is a delightful summer addition to any wooded area.

THE REDBUD

PAUL A. KOHL

Two of our native trees, redbud *(Cercis canadensis)* and flowering dogwood *(Cornus florida)* may never be grown in many of our gardens for lack of space, but we do admire them in the country. The flowers of both trees appear before the leaves, making them stand out in the landscape and inviting us to a closer inspection of their beauty.

Cercis canadensis var. *alba*

Redbud *(Cercis canadensis)*, a 12-year-old tree growing in the open

While redbud usually grows in partial shade, mixed with other hardwood trees, it does equally well in full sun. It then develops into a round-topped tree, fifteen to twenty feet high. The color of the flowers is not red, as the name would indicate, but rather rose-pink and rose-purple. A mass of redbud trees in full bloom, mixed with the pale green of the unfolding leaves of other trees, is a beautiful sight. The leaves that follow the blooming period are large, almost round, green all summer, changing to yellow in the autumn.

Many seeds are produced each year in the clusters of flat, pea-shaped pods which hang on the trees during the fall and winter months. If these seeds are sown in a cold-frame, seedlings will appear the following spring. These may be left in the frame for a year and then transplanted to the garden or grown for another year in the nursery. Young trees, two and three years old, are at the best age for transplanting to the garden. Older trees are difficult to move and many of them succumb, but a three-or four-foot whip, planted in March or April, will grow. It is surprising, what a fine tree will develop within a few years.

There is a variety with flowers of purest white (var. *alba*) and though it was discovered some fifty years ago, it still is a rare plant and is seldom listed by nurserymen. This white form was described and illustrated in the Garden BULLETIN of June, 1922. It was found in 1938, growing wild on a farm near Pacific, Mo. (April 1938 BULLETIN), and it is hoped that it may soon be obtained as readily as the common form. To call it "White Redbud" seems inconsistent, so why not call it "Whitebud?"

It is also interesting to know that a double form of redbud exists (var. *plena*). The tree is like the common species in every respect, excèpt that the individual flowers are double and each flower cluster forms a rosette, about the size of the blossoms of a double-flowering peach tree. This double-flowered variety was described in the May, 1935, Garden BULLETIN.

THE FLOWERING DOGWOOD

PAUL A. KOHL

Redbud is in flower in Missouri for about two weeks in early or late April, as the seasons vary, and usually about the time its flowers fade, dogwood *(Cornus florida)* begins blooming. In some years, however, weather conditions cause both trees to flower at about the same time, and then the spring landscape is breath-taking.

Dogwood grows tall and slender when in close association with other native trees, but in the open it forms a low, round tree. At any time of the year there is something interesting or beautiful about this tree. All through the winter months the large, terminal flower buds contain the promise of a fine display in spring. And when it does come, the branches are tipped with white as if they held the flakes of the last spring snow. One would like to say each flower is composed of four white petals, but what usually are called petals are the showy bracts surrounding the small, greenish, tubular flowers. Then come the leaves to nourish the trees, and when their work is done they are among the first to change from green to a brilliant red.

Flowering Dogwood in its native habitat

The clusters of bright, red fruits ripen in October and are eagerly sought by the birds. If one is fortunate enough to collect the seeds before the birds strip the trees, they may be sown in frames, like redbud seeds. To free the seeds from the pulp, mash and wash the fruits in a sieve, then dry the seeds by spreading them on paper. One-inch mesh wire netting, spread over the surface of seed-frames, will prevent rodent damage during the fall and winter months. Seedlings will appear in spring, but some of the seeds will remain dormant until the following year. Seedlings may be left in the frame

Flowering Dogwood fruits

Clusters of Dogwood flowers surrounded by four white bracts

until the following spring and then transplanted. After the seedling stage, young dogwoods should be moved with a ball of soil around the roots. Flowering Dogwood trees are difficult to transplant successfully and must be handled with care to avoid disturbing the roots.

The bracts of our native dogwood are white, but there are varieties of various shades of pink which are reproduced by grafting on seedlings of the native species. They are beautiful trees and are cherished by all who grow them. It is well to remember that since the pink varieties are grafted plants, no suckers should be left to grow from the base of the plants.

THE SILVER-BELL TREE

PAUL A. KOHL

Of all the white-flowered shrubs and trees that bloom in spring, the Silver-bell or Snowdrop Tree *(Halesia carolina)* is one of the handsomest. Either popular name is appropriate. Call it Silver-bell and see how the many white blossoms appear as little bells studded along the branches. Or look at the flowers of the snowdrops, those heralds of the coming spring, and notice their resemblance to the blossoms of the Snowdrop Tree.

In its native home, particularly in the Great Smoky and Blue Ridge mountains of North Carolina and Tennessee, the Silver-bell reaches its greatest size. In gardens it seldom grows much more than twenty-five feet tall, and more often it is seen as a broad shrub. Since the plant suckers freely, the gardener has the choice of training it as a shrub or letting it grow as a tree. No matter what shape the plant assumes, the branches are

Silver-bell Tree *(Halesia carolina)*

lined with innumerable white bells each April, usually in the latter part of the month. The four-winged fruits ripen in late autumn and remain on the trees until early winter, when they are finally blown away by the wind. They are from one to two inches long and develop from a four-celled ovary, but seldom mature more than one or two seeds. The wings of the dry fruits are brittle and can easily be broken off, but the core is extremely hard. Such hard seeds are always slow to germinate and the dormancy must be broken before germination can be accomplished.

Blossoms of Silver-bell Tree

In 1932, Giersbach and Barton (in Contributions Boyce Thompson Research Institute, Vol. 4, pp. 27–38) described their work with germinating seeds of the Silver-bell Tree. They secured germination in less than a year when the seeds were planted in flats in October and November and kept in a warm greenhouse until January, at a temperature ranging between 70° and 80° F. The flats were then placed in a cold-frame and covered with boards until late spring, when the seedlings appeared.

Halesia carolina will grow in any good garden soil that is well drained. As for location, it does equally well in full sun or part shade. Plants may be obtained from most nurseries and if it is not listed with the trees, it will be found among the shrubs under the name of *Halesia carolina*, or in some catalogues as *Halesia tetraptera*. Silver-bell Trees in the smaller sizes will transplant better than the larger ones.

Halesia was the name given to the genus in 1759 to honor the memory of Stephen Hales (1677–1761), a noted botanist, who wrote one of the first English books on vegetable physiology. The Garden library is fortunate in having the first edition of this book, printed in 1727, under the title of:

Fruits of Silver-bell Tree

"Vegetable Staticks—Or, An Account of some Statical Experiments on the Sap in Vegetables: Being an Essay towards a Natural History of Vegetation."

Silver-bell has been written in the following ways in different horticultural works: Silver-Bell—Bailey's "Hortus"; Silver Bell-tree—Rehder's "Manual of Cultivated Trees and Shrubs"; Silver-bell Tree—Norman Taylor's "The Gardeners' Dictionary"; Silverbell—U. S. Dept. Agr. Misc. Publ. 654, "Woody Plant Seed Manual."

"MIMOSAS" IN ST. LOUIS

ROBERT W. SCHERY

Are you among those having noticed for the first time recently a beautiful feathery tree commonly called "Mimosa" that is receiving increasing attention? A number of St. Louisans have only within the last decade become familiar with this Mimosa, and almost invariably express admiration and amazement at its exotic, tropical beauty when in flower. The tree has been grown at the Garden Arboretum since 1926, and a number of specimens have recently been planted facing Highway 66. These have just started to flower and should become increasingly spectacular each year.

Actually this tree is not a species of the genus Mimosa, although the flower head is very similar. It is *Albizzia julibrissin*, and, like the true Mimosas, a member of the Mimosoideae subfamily of the Leguminoseae or

Pea family. It is native to Asia from Persia to China but has long been grown in our South. The sole variety that has proven reliably winter-hardy in St. Louis is *A. julibrissin rosea,* with reddish flowers (stamens) and of smaller stature than the species proper. The variety has frozen back at the Arboretum only once since 1926. The species becomes quite large in the South. In Virginia, for example, trees almost as large as our familiar maples and oaks are not uncommon. Nearer home, Albizzia has been used in Jefferson City as a shade tree, but is hardly to be recommended for this purpose.

Showing trunk of *Albizzia julibrissin rosea* at Wheelock home

Flowers and foliage of *Albizzia julibrissin rosea*

In the St. Louis area one of the largest specimens of var. *rosea* to come to my attention is a 12-year-old (from seed) specimen at the home of Mr. and Mrs. Thomas H. Wheelock in Webster Groves. This tree is approximately 30 feet high, and overhangs the southern half of the Wheelock house. Trunk circumference near the ground (it soon branches into 3 trunks) is about 45 inches.

The reader has probably gathered from this that *Albizzia julibrissin* is a fast-growing tree. It is not unusual in this species for each twig to grow several feet each year. Another specimen in Webster Groves, on Armin Ave., is about 20 feet tall and at least as broad in crown. This tree is about seven years from seedling, indicating an over-all growth of at least two feet per year. Thus the species is not only tropical in appearance but also in luxuriance of growth where soils are suitable.

Albizzia julibrissin is impressive on two counts, flower and foliage.

Individual flowers are so small and delicate as to be scarcely visible (perianth greenish-white, tubular, about ¼ inch long), but from them the slender colored stamens protrude for more than an inch. Many of these flowers are clustered to make an axillary inflorescence or head, from which the stamens extend in all directions to form a delicate ball of rose-colored "fluff." Such inflorescences (see illustration) are borne by the hundreds on a good-sized tree, and offer a truly spectacular display in St. Louis in late June and into August. This being a season when flowering shrubs and trees are scarce, Albizzia is particularly welcome.

The second point of attraction is the foliage. This is fine and feathery, giving a delicate appearance to the tree and permitting plenty of light for planting below the spreading branches. The leaves are twice divided (bi-pinnate) with the ultimate leaflets only a fraction of an inch long and scarcely ⅛ inch wide. Of course, each leaf bears hundreds of these leaflets on 3–25 pairs of pinnae. As in clover and a number of other legumes the leaflets close—that is, fold together at night when the tree "goes to sleep."

Albizzia julibrissin develops a wide-spreading crown, usually broader than the tree is tall. Because of this and its rapid growth the tree should be given plenty of room. It will thrive in a variety of situations, but, as with almost any plant, does best in good soils and ample sun. It needs no special attention and in this area it seems to be free of insect pests and serious diseases. In the South it is being attacked at present by a fungus (Verticillium), which has become serious enough to warrant the United States Department of Agriculture publishing a circular (No. 535) concerning it.

Seeds are produced in broad flat pods, and germinate readily. Propagation, however, is probably more reliable by cuttings. We can expect to see a lot more of *A. julibrissin rosea* in the St. Louis area, although for some time it will probably be viewed by the general public as a striking novelty. The species certainly merits the comment it inspires any time that it can put on a floral display of the volume and quality manifest in 1950.

With more varieties of Azaleas being planted every year and with the established ones becoming larger, the display of these shrubs at the Garden becomes more spectacular each May. The principal beds are north and west of the mausoleum grove, but there are many Azaleas planted around the Old Residence and in the knolls. This year they seem to have been not a bit harmed by the relatively severe winter which caused damage to other plants; roses, for example, having suffered considerably from being frozen back.

TWO NEW PYGMY WATER-LILIES

GEORGE H. PRING

Water-lily enthusiasts repeatedly ask, "Why don't you breed some tropical water-lilies like the hardy *Nymphaea tetragona*, which are suitable for growing in tubs or small pools?" Dr. H. S. Conard, an authority on water-lilies, writing of the tender day-blooming kinds, states:[1]

YELLOW GLORIES TO COME

> There are two treasures awaiting introduction and which promise great things. Africa hides in its vast interior two yellow tender species allied to the present blues and whites. One has excellent double flowers six or seven inches across,—*Nymphaea Stuhlmannii*. The other, *Nymphaea sulphurea*, is a pigmy with flowers and leaves two to three inches in diameter. Aside from their individual attraction, think what a future they offer for hybridization! It is earnestly hoped that they will not long be absent in our gardens.

Twenty-five years after the above was written the Missouri Botanical Garden successfully introduced the large yellow water-lily to cultivation,[2] and it has proved to be an excellent parent in the writer's water-lily breeding (Mo. Bot. Gard. Bull., Vol. 37, p. 70. 1949). Dr. Conard's tropical pygmy, *Nymphaea sulfurea*, was still awaiting introduction when the writer visited the Royal Botanic Gardens, at Kew, England, in 1948, but Mr. Milne Redhead and Mr. Robert Trickett offered to contact botanists in Africa who would try to obtain viable seeds or tubers of both species. On August 30, 1949, a single tuber of *N. sulfurea* was received from Trickett, which had been collected by Mr. P. J. Greenway of the East African Herbarium, Nairobi, in Shiwa Ngandu, northern Rhodesia. It was planted outdoors at the Garden in a half-barrel in May, and despite its poor condition upon arrival it produced a fine flowering spike during the summer of 1950. The first flowers were self-pollinated to obtain seeds for stock. Half of the seeds were sent to Trickett since it is much easier to obtain tubers and seeds in our climate than in England where tropical water-lilies have to be grown in the greenhouse.

On February 7, 1950, seeds of *Nymphaea heudelotii* arrived at the Garden, also sent by Trickett. They had been collected by Mr. R. D. Meikle, of the Kew Gardens, while on a visit to Nigeria, from plants which he saw flowering in a pond by the roadside at Kontagora. Upon arrival at the Garden they were sown in pans and placed in propagating tanks in the green-

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[1] Conard, H. S., and Hus, Henri. Water-lilies and how to grow them. p. 121. 1907.

[2] This was described as a new species, *Nymphaea burttii*, in 1933 (Ann. Mo. Bot. Gard. 20:1–6), since at that time only a photograph of the fragmentary type specimen of *N. stuhlmannii* from the Berlin Botanical Garden was available for comparison with Burtt's African material. However, when the writer was at the Kew Herbarium, he was shown excellent dried specimens of Burtt's collections of *N. stuhlmannii* which seemed to be identical with the Garden's *N. burttii*.

Nymphaea hendelotii

Nymphaea sulfurea

TWO PYGMY WATER-LILIES RECENTLY
INTRODUCED INTO CULTIVATION

house. Within three weeks they showed excellent germination. The plants were placed outdoors about the middle of May in a half-barrel pool. Self-pollinations were made to increase stock, and selection and crossing between *N. sulfurea* and *N. heudelotii* will be made to produce new pygmy water-lilies.

The following descriptions are of plants grown in pools outside; when grown in the greenhouse there is a slight variation.

Nymphaea sulfurea Gilg.—Native of northern Rhodesia. Flowers Picric Yellow[1], 3–3½ inches across, sweet-scented; sepals 4, narrowly lanceolate, acute-tipped, 1½ inch long, ½ inch wide at the middle, Oil Green on the outside, Citron Green on the inside, with 10 prominent parallel veins; petals 10–13, narrowly lanceolate, acute, 1½ inch long, ½ inch wide, inner whorls Picric Yellow, outermost whorl Citron Yellow, green along the middle on the outside; stamens 60–66, Picric Yellow, linear, outer whorl 1 inch long, inner whorls as short as ½ inch; carpellary styles 12–14, Picric Yellow; ovary cup-shaped; peduncle brown. Leaves of submerged seedling copperish; first floating leaves dark green, red below, margins red; mature leaves 3–4 inches across, orbicular, dark green with red margins, under-side brown and pubescent with age; lobes open at base; petiole brown.

Nymphaea heudelotii Planchon.—Native of Nigeria. Flowers 2–2½ inches across; sepals 4, lanceolate, acute, 1¼ inch long, ¼ inch wide at the base, pale green striped with purple on the outside, white on the inside; petals 7–9, lanceolate, acute, 1¼ inch long, ¼ wide at the base, inner whorls white tinged with pale blue the first day, outer whorl pale green striped with purple; stamens 20–23, yellow with white tips, outermost whorl ½ inch long, inner whorls much shorter; carpellary styles 6–8, dark yellow; ovary cup-shaped; peduncle brown. Leaves of submerged seedling copperish; first floating leaves dark green with red margins, dark red on the under side; mature leaves 3–3½ inches across, orbicular, dark green with red margins, with age under-side brown and pubescent; petiole brown.

[1]Capitalized color terms are those of Ridgway, Color standards and color nomenclature.

Another native wild flower has been successfully naturalized in the Arboretum. Last spring Mr. Louis G. Brenner, of the Arboretum staff, discovered the Indian Paint Brush *(Castilleja coccinea)* flowering in profusion on a glade along the Robertsville Road, a few miles from the Arboretum. Later in the year he transplanted several plants to a similar site on the Arboretum wild-flower area and broadcast ripe seed. The transplants did not survive, probably because the Indian Paint Brush is usually partly parasitic on near-by plants, but several vigorous seedlings were established and flowered during April.

NOTES

The City Planning Commission and the Garden Club of Washington, Mo., visited the Arboretum recently.

Dr. Edgar Anderson, Geneticist to the Garden, is one of the five Michigan State College alumni who will receive the 1951 alumni award for distinguished service at the commencement of the college on June 3.

Dr. Henry N. Andrews, Paleobotanist to the Garden, has been awarded a Guggenheim Fellowship effective from July 1951–February 1952. He will spend most of that time at the Botanical Museum of Harvard University studying the fossils he has recently collected in Kansas and Illinois.

The members of the St. Louis Horticultural Society were guests of the Arboretum on April 15, and were conducted through the grounds by Mr. Louis G. Brenner, Assistant Manager. Before the tour Dr. Edgar Anderson spoke on "Narcissi." After the tour Mr. and Mrs. G. R. Lowry, of the orchid department, spoke and gave a demonstration on the growing of orchids from seeds.

Dr. Harry J. Fuller, professor of botany, University of Illinois, spoke before the graduate seminar at the Garden on modern trends in teaching, April 25. Other recent visitors to the library and herbarium were: Dr. Joji Ashida, of Kyoto University, Japan; Dr. Balaji Mundkur, of Southern Illinois University, Carbondale; Dr. Carl O. Sauer, of University of California, Berkeley; Dr. Jonathan D. Sauer, of University of Wisconsin; Mr. Thomas MacDougall, of New York City, who has just returned to this country from a collecting trip in Mexico; Mr. James D. Ray, graduate student at the University of Illinois, Urbana; Mr. Lars Wickman and Mr. Bengt Söderstam, publisher and vice-president respectively of Nordisk Rotogravyr, Stockholm, Sweden.

Mr. George H. Pring, Superintendent of the Garden, sailed for England on May 8, to preside at the annual meeting May 23, as the first American president of the Kew Guild (alumni of the Royal Botanic Gardens, Kew). While in England he will attend the Flower Show of the Royal Horticultural Society, at Chelsea, acting as one of the judges of the orchid section. At the Kew Gardens he will spend some time in the herbarium studying specimens

of Nymphaea water-lilies for the possibility of discovering new African species suitable for breeding work in St. Louis. Herbarium research at Kew in 1948 resulted in the introduction of the two pygmy lilies described in this BULLETIN.

Dr. Gustav A. L. Mehlquist, Research Horticulturist to the Garden, has been invited to attend the Royal Horticultural Society Conference on Plant Breeding to be held in London, July 10–14, and will give a paper on "Chromosomes and Plant Breeding." On his return from England he will go to Ontario Agricultural College, Guelph, Canada, where he will speak at the annual short course for florists on the "Production of Disease-resistant Carnations through Breeding."

On June 14–17 the Central States section of the Botanical Society of America will conduct its summer foray through the Ozark region. Registration for the tour will be at the Garden the afternoon of June 14, and a supper and evening meeting at the Garden will open the 4-day program. In keeping with the theme of this foray the June issue of the BULLETIN will deal with the developmental history and floristics of the Ozark country.

A group of thirty local orchid enthusiasts met at the Museum Building on February 3 (after visiting the Garden orchid show) to form the Orchid Society of Greater St. Louis. The officers elected were as follows: President, Mrs. Fristoe Mullins; Vice-presidents, Dr. L. W. Dean, Jr. and Mr. John E. Neis; Secretary, Mrs. L. B. Read; Treasurer, Mr. R. F. Nagel. Mr. Pring and Dr. Mehlquist, of the Garden staff, are members of the Board. The Society will meet on the second Friday of each month.

SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 50,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

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Missouri Botanical Garden Bulletin

Vol. XXXIX JUNE, 1951 No. 6

THE OZARKS

Where East Meets West and North Meets South in the Heart of the Nation

ROBERT W. SCHERY AND ROBERT B. NEVINS

Now and then one has the good fortune to glimpse a natural beauty spot unspoiled by man. He watches a thunderstorm approach during the night, drinks from a transparent and unpolluted stream, is filled with awe by a majestic unexploited waterfall, or observes the wind ripple of the virgin prairie. The grandeur of snow-capped peaks or the solemnity of a primeval rain-forest can never be the heritage of this nation's great midland, but in the ancient Ozark country of southern Missouri the wondrousness of nature will be revealed to those who will live intimately with the wildness. There spring-fed streams run crystal clear and cold against carved limestone bluffs that command each turn of the river, silent sentinels harboring secrets of a tumultous past; but the pulse of wildness will not be felt by those who are looking only for as many bass as can be hooked, or for board feet of white oak, or for the comforts of motor road and cabin.

The boundaries of this Ozark heritage are rather ill defined. The "Ozarks" lie in general south of the Missouri, west of the Mississippi, and north of the Arkansas rivers, extending west briefly into Oklahoma. Major lines of travel have mostly skirted the Ozarks, and the colonization of this region has not kept apace with that of the surrounding plains. Thus this age has been bequeathed something of a midwestern wilderness containing no sizeable cities (although St. Louis lies at the northeastern fringe). In the geological sense, there are no Ozark "mountains," this popular appellation referring to some 50,000 square miles in southern Missouri and northern Arkansas, historically a plateau but today dissected by some of the nation's finest clear-water streams (see cover). This plateau includes the Boston Mountains of Arkansas and the Salem Plateau and Springfield Plateau (and St. Francis Mountains) of the "Ozark Plateau." The Boston Mountains have general elevations of about 1800 feet and at times reach to 2500 feet. They are the most rugged

in the Ozarks, with a local relief of about 800–900 feet. Northward in Missouri some "peaks" reach 1700–1800 feet, but generally the relief is about 300–400 feet.

The natural history of this region is closely related to its geological history. Inexorable forces of the past have given us the extremely different massive granite hills of the St. Francis Mountains, habitat for acid-soil plants (pine, huckleberry, rhododendron); and the extensive rolling uplands, knife ridges, and majestic bluffs of the surrounding limestone country, rich in sinks, springs and drip-drenched cliffs, afford habitats for numerous odd and ancient species.

The oldest rocks now exposed in the lower Mississippi Valley are to be found in the St. Francis Mountains. These are fine-textured porphyry lavas, possibly a billion years old, today underlying acid soils that are habitats for species uncommon elsewhere in the state (see page 130 of this BULLETIN). The flows were originally of great thickness, and one may well imagine the awesome sight of a land covered with red-hot lava, above which low-hanging clouds turned ruddy at night in the reflected glow of myriads of volcanoes. After the lava had cooled, a tremendous mass of molten rock was thrust

Fig. 1. Diabase dike through granite. Old Silver Mine, on St. Francis River, Iron County.

upward, melting and absorbing some of the lava as it came. Doubtless such tremendous subcrustal displacement from the bowels of the earth was not without earthquakes of terrible violence. The invasion halted with one-half mile or more of lava remaining above the molten rock. The rock thus cooled very slowly, forming a coarse-grained granite through whose cracks a black to green diabase rock was forced from deep within the earth at a still later date. This entire region was then raised into a dome, at least 2000 feet high, and on this bare dome inevitable erosion began its persistent gnawing away. At this time there were no land plants or animals, and it is problematical whether life existed anywhere on earth. The landscape of harsh red knobs, deeply scored by primeval rivers, must have indeed been bleak. Ages later, the region had become comparatively reduced, with a maximum relief of little more than 900 feet. The knobs we now know as the St. Francis Mountains are these very hills emerged from long hiding under a cloak of softer rocks.

The softer sedimentary rocks were deposited many millions of years ago when the granite hills slowly sank under the sea, the hilltops first becoming islands, then completely disappearing. In the depths of the sea, sandstones and limestones were laid down, until finally the entire granite mass lay under several thousand feet of sedimentary rock, embedded in which were the shells and other fossil remains of the strange creatures of that epoch. This sinking must have begun about 400,000,000 years ago. At times the land surface did emerge, but never was it very high out of water. During this interval land plants appeared, as did the amphibians, foreshadowing the age of the dinosaurs.

When dinosaurs roamed a far different world than ours, about 100,000,000 years ago, the present Ozark area was again out of water, but it was flat and monotonous. For the first time, had we been present, we might have recognized some of the plants—likely all trees or shrubs, since modern herbs had seemingly not yet evolved. This interlude in the Ozarks' history was followed by another doming movement, centered again in the St. Francis region. An imaginary picture reveals a limestone dome a few hundred feet high, down which a few rivers run to its flanks. This is a primeval glimpse of a modern scene, for these rivers survive to give us the present Current, St. Francis, Black, Northfork, Meramec and Gasconade rivers. These rivers once more leveled the region to a flat, low plain, with the top of the granite knobs quite close to the surface, if not actually exposed. As the land became flatter, the streams began to wind, just as the Mississippi River does at present. Then, about 1,000,000 years ago, just before the Ice Age a third and final doming of the St. Francis region occurred, this time raising it about

1800 feet. The rejuvenated streams, still swift and dashing today, followed the wandering course characteristic of the old, sluggish rivers of the Pliocene flatland.

Erosion has today proceeded sufficiently to uncover a few of the age-old granite knobs at the highest point of the uplift. But over the greater part of the Ozarks the now elevated, but still flat (or gently rolling), surface of the last near sea-level plain is to be seen in the highlands. Into this plain the rivers have cut the spectacular valleys with precipitous bluffs for which the area is justly famed. However, the true character of most Ozark mountains is apparent, in that they are actually ridges between valleys. One may notice that all of the ridge-tops are approximately of the same level, corresponding to the ancient plain.

Fig. 2. Calcimined limestone bluffs display on their sheer faces a scattered flora of hardy types. Jacks Fork.

Perhaps the best way to become familiar with the unspoiled beauty of the Ozarks is to travel by canoe or john-boat down rivers such as the North Fork, Current, or Jack's Fork. The chutes are tricky and no place for one unwilling to chance a dunking. The Jack's Fork has been declared one of the nation's ten best fishing streams, and all the Ozark rivers are famed for their small-mouth bass and "jack-salmon" (wall-eyed pike). Fishermen from all over the nation gather during fishing season for the float trips, in which sleek john-boats are launched in the headwaters of a stream, lazily float to a predetermined point to be met by truck. New vistas unfold at each turn of the river's tortuous course. On the outer side of the bends the down-cutting river has created tremendous calcimined bluffs, some over 400

Fig. 3. A gravel bar at a bend of the Upper Jacks Fork sustains little more than a few willows and sycamores.

feet high, on which precariously perch gnarled junipers, sometimes draped with lichens closely resembling Spanish Moss. From time to time one sees in the river beneath these bluffs huge blocks of limestone that have been undercut and fallen, and have yet to be vanquished by the river. Opposite the bluffs are generally found low, open gravel bars, perhaps just being invaded by small sycamore, willow, or witch-hazel. Eventually these trees (or shrubs, at this stage) will capture sediment floating down the river and build it into soil for a flat of towering lowland forest. Alongside this forest, the restless river continues to run cold and clear, never silent. There the nights are pleasantly cool, and the whip-poor-will sings soprano to the barred-owl's bass in a toast to a dwindling outpost of wilderness.

The omnipresent brown chert that covers the gravel bars originates from limestones laid down during the ages of submergence. These generally con-

tained considerable quantities of very hard, relatively insoluble chert. Since the emergence of the land from the sea, water has been percolating through the humus of the forest floor, and the trickles of acid-charged water have slowly dissolved the limestone, leaving behind insoluble chert pebbles. They sometimes form layers many feet thick. The rocky soil so formed renders farming quite difficult, but the chert does help to keep the thin soil on the hillsides, at least in sufficient quantity for timber growth. Where surface limestones were free of chert, as in the White River region, the soil is more likely to be washed away, forming "balds" of exposed rock on the hillsides. These balds father a very specialized flora, including the American Smoke Tree *(Cotinus americanus)* and *Delphinium treleasei* (found only in this area). Other members of the "balds" community, including the striking Missouri Evening Primrose, are found in similar habitats on the glades throughout the state. In many large valleys, where one would normally expect to find a creek, the surface is bone-dry, the water having drained through the chert pebbles, often to emerge elsewhere as springs.

The dissolution of the limestone has another and even more striking effect. Trickles of acid-charged water working along minute cracks in the limestone gradually enlarge them and unite with other trickles to form subterranean streams and rivers. These eventually gush forth as spectacular springs, second in profusion only to those of the Snake River basin in Idaho. Some of these springs are unbelievably large. Big Spring is possibly the largest single-outlet spring in the United States (Silver Springs, in Florida, its only rival, is actually the product of several outlets). Its average flow is more than sufficient to supply the entire water needs of a city as large as St. Louis. The maximum observed flow of this spring is 840,000,000 gallons per day. As with other Ozark springs, Big Spring emerges with great violence at the base of a sheer bluff, with force sufficient to maintain a constant boil about 2 feet high over the orifice. In the face of this and other bluffs there are many abandoned openings from which springs emerged before the valleys had eroded down to their present level. Many channels of former subterranean streams abound in the region, some quite famous. Meramec Caverns and Onondaga Cave on Highway 66 southwest of St. Louis are but two examples.

Other springs emerge quietly in deep, clear pools, although the cavorting spring branches typically bid a gay adieu to the sedate majesty of the pool. In the cold (58° F. the year 'round) springs and spring branches are found many unusual mosses, algae and always quantities of crisp watercress (most useful for garnishing the campers' sandwiches). Some springs were used in former times to power grist mills, and at many, Alley Spring for instance,

Fig. 4. Alley Spring branch rushes to meet the Jacks Fork, Shannon County.

the picturesque mills may still be seen. Some of the more accessible of the large springs are now state parks, but others, of especial glory in their wild settings, are accessible only by boat from the rivers.

In places the collapse of cavern roofs have formed sink holes. Sometimes sinks form the heads of valleys—an unaccountably abrupt beginning for a valley to one not acquainted with the cause. In other places natural bridges are found, as at Grand Gulf, near the Arkansas border of Missouri; or at Jam-up Bluff on the Jack's Fork, where a small stream flows directly through a large bluff into a huge, somber cave and thence into the river.

In the region of the St. Francis Mountains the ancient valleys are today known as "shut-ins," where massive crystalline boulders clutter the floors of little streams running through deep gorges of red granite. The great resistance of this rock to the stream's action has in places prevented deeper erosion of more recent sedimentary rocks upstream. At present the St. Francis area is the center of most mining in the Ozarks, lead being found about the bases of these ancient knobs. The Ozarks constitute the nation's leading barite- and lead-mining area, and some iron has been mined, especially on Iron Mountain. The granites and porphyry are quarried for building-stone and monuments, a modest local enterprise.

Inasmuch as the Ozarks have been above sea level since Carboniferous time and subject to many changing conditions, each of which left its imprint on the plants inhabiting the region, it is not surprising to find elements of many different floras in isolated localities. Included are remnants of what are now the southern coastal plain flora, the present Appalachian flora, the Great Plains flora, and, on north-facing bluffs, vestiges of a boreal flora (see pp. 133–134).

In the struggle for existence oaks and hickories have come to dominate the hills, and short-leaf pine dominates some of the acid, cherty ridges. Much of the Ozark area is today clothed in dense stands of second-growth hardwoods, although prior to about 1850 open grassland was more prevalent. Records indicate that an early Spanish governor was able to drive a coach-and-four from New Madrid to St. Louis, certainly impossible through dense forest in a day of no roads. The invasion of dense forest seems to have been, at least in part, prevented by widespread prairie fires, possibly set by the Indians. Today, however, heavy growth of timber provides one of the chief sources of income for the area. The extensive stands of white oak are particularly valuable, being used for tight cooperage (for whiskey barrels in particular). Before inordinate cutting, the shortleaf (yellow) pine was an important source of income for early settlers.

Fig. 5. "Shut-ins" where the St. Francis River has cut through granite near Old Silver Mine, Iron County.

When white man first came to Missouri, elk, buffalo, bear and mountain lion were to be found in the Ozarks. All are now gone; the only big game to be found nowadays is the White-tailed Deer. Once in considerable danger of extinction the species has been reestablished through intelligent management by the Missouri Conservation Commission. Beavers, once virtually exterminated also, are becoming common on some of the rivers. Small game such as squirrel, rabbit and 'coon is abundant, while fox and even wolf are not uncommon. Huge flocks of robins and Carolina Wrens winter in the valleys, while ospreys voice their displeasure as the canoe disturbs the solitude of their domain. Once, while on a canoe trip, the authors encountered an immense colony of great blue herons—40 nests being counted in two huge sycamore trees bordering the river. Any night, winter or summer, along the enchanting valleys the endless sounds of nature may be heard—the shrill chit-chat of frogs, the eerie cry of the owls, the turbulence of the river, perhaps the baying of hounds trailing some "crittur"—all combining in an ancient Ozark country to awaken appreciation of the rhythm of natural events in a day of increasingly unnatural environments. There comes to one here the realization of powers older and greater than man, who often forgets that he appears in but a very brief scene that unfolds over rocks incalculably ancient before ever there was man.

June, the month the poets sing about, is not the best month for wildflower bloom in the Ozarks. It is, in fact, the poorest month during the growing season. The spring burst of bloom, which starts slowly here in March, reaches a crescendo in late April or early May and then slumps rapidly. The long-blooming species which are so brilliant in the summer, such plants as the Trumpet Creeper, *Campsis radicans*, are just coming into bud, and the native vegetation is in a kind of green lull between spring display and summer display. The landscape has some colors in the meadows because the European meadow plants which have followed man across the Atlantic seem to be following much the same rhythms as in their native homes. Yarrows, daisies, and clovers blossom here in June just as they did in their original meadows. Of truly native species there are no more in flower in early June than in late March. By the end of the month, summer bloom will be under way, to rise gradually, week by week, through July and August before it merges with the brilliant burst of Composites in the autumn.

BOTANICAL AREAS IN THE MISSOURI OZARKS

JULIAN A. STEYERMARK

To the casual tourist speeding along the highways the Missouri Ozarks may give the impression of a more or less continuous rolling forest land interrupted here and there by gravel-margined streams overhung in places by rocky bluffs. To others, the Ozarks may mean all this plus beautiful springs and caves and fishing places. For the naturalist and botanist this area is a vast storehouse of varied and interesting plant and animal life. In addition to the forests, bluffs, springs, and caves, little-known plant haunts exist, which include sink-hole ponds, swampy meadows, salt licks and springs, relict prairies, and isolated bluffs and rocky canyons.

RELATION OF UNDERLYING ROCK TO PLANT DISTRIBUTION

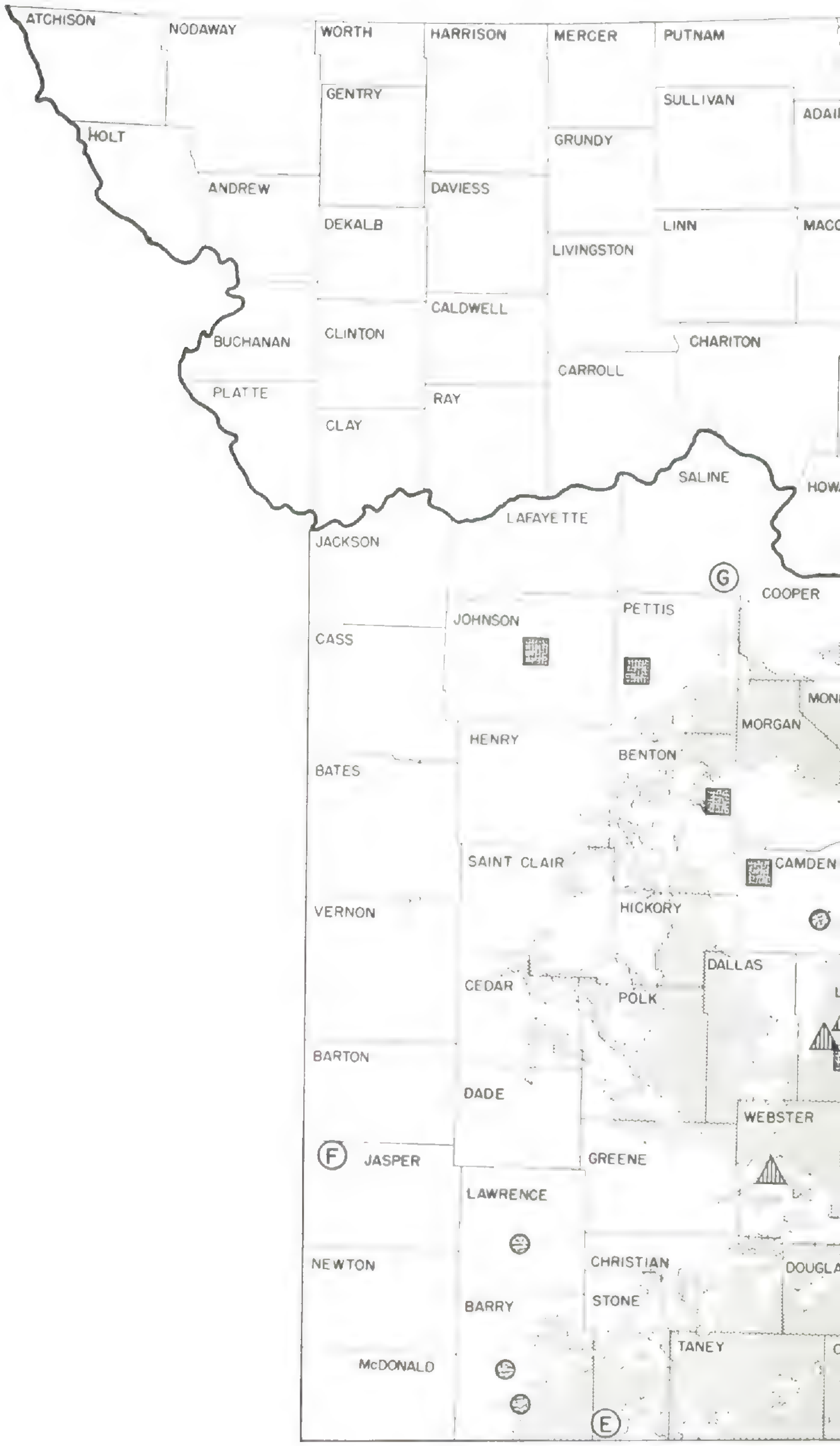
The great complexity and diversity of the Ozark flora are due principally to the varied topography, different exposures, and to types of residual soils. The varied topography accounts roughly for the association of certain plants within various habitats. Some species are confined to bluffs and slopes or shaded canyons or dissected portions of the country where the need for shade, moisture, or drainage is important. Other species are influenced by type of exposure, those of the more shaded and usually moister east- and north facing slopes being similar and quite different from those of the drier and more wind-swept sun-beaten south and west slopes. However, the distribution of the vegetation is most markedly affected by the residual soils and rocks from which the soils have been derived. Where the rock is close to the surface and the soil is thin, the correlation between plant distribution and rock outcrop is very close. The sandstones, chert, and granitic regions harbor very definite and restricted floras that tolerate acid and sub-acid soils, while the limestone regions support a vegetation always found around calcareous outcrops. Where the soils are more weathered and more thoroughly mixed with decayed leaves, circumneutral soils result. Nodules of interbedded chert in limestone regions often become weathered and leached out, producing an acid soil within the limestone region.

Most of the rocks found in the Ozarks are sedimentary—limestones and sandstones chiefly. The exposed rocks are principally Cambrian and Ordovician limestones, sandstones, dolomites, and chert. The igneous rocks are the granites, rhyolites, and porphyritic trachytes, found only in the eastern portion of the Ozark region. Some of the rockiest areas are those known as "glades" and "barrens" and "bald knobs," where the substrata of rock are exposed and broken into small residual weathered fragments. Glades and barrens are produced by each kind of sedimentary rocks, and the topographic expression is quite different for each kind.

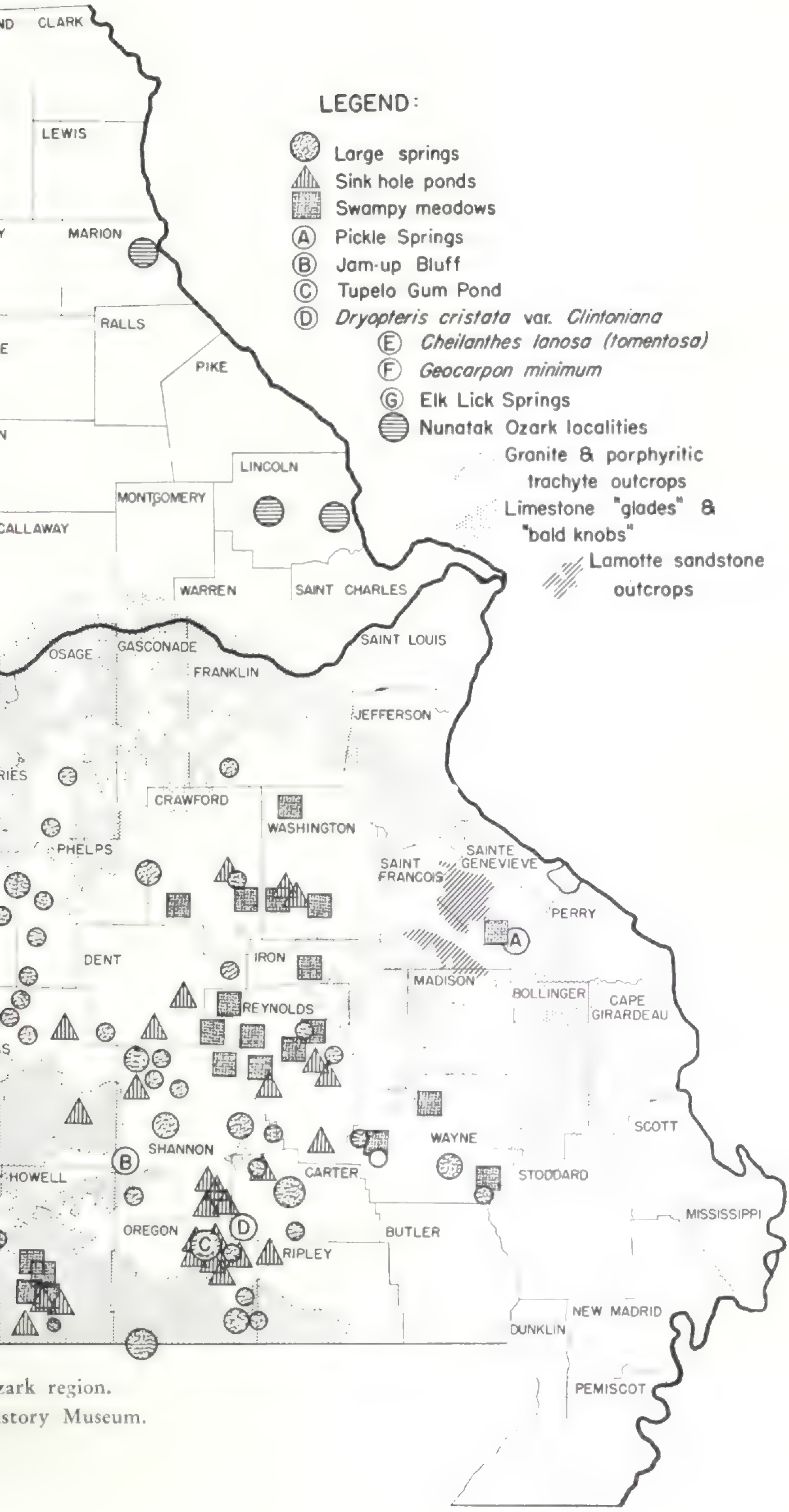
These barrens or glades are covered mostly by an herbaceous flora which has adapted itself to xerophytic conditions. Examples of plants in this flora are: short-lived annuals (*Heliotropium tenellum* and *Centaurium texense*); bulbous perennials (*Allium stellatum*, *Erythronium albidum* var. *mesochoreum*, *Nemastylis geminiflora*, *Oxalis violacea*); fleshy-leaved plants (*Talinum calycinum*, *Sedum pulchellum*, *Agave virginica*); plants sending down deep tap roots into the rocky substratum; and plants provided with various morphological and physiological features to reduce evaporation, such as reduced leaf surface (as in Pineweed, *Hypericum gentianoides*) or a covering of dense tomentum or scales on the leaves and stems (as in Missouri Primrose, *Oenothera missouriensis*, *Heliotropium tenellum*, *Croton capitatus*, *Crotonopsis elliptica*). The limestone and dolomite glades give rise to a calcareous soil, of which red cedar (*Juniperus virginiana* and var. *crebra*) is characteristic. Other calcareous outcrops occur along bluffs. The sandstone, chert, and granitic barrens tend to produce an acid soil which supports a large assemblage of species. The limestone glades of southwestern Missouri harbor many rare species, a large number occurring nowhere else except in Arkansas, eastern Oklahoma, and Tennessee. A Larkspur (*Delphinium Treleasei*), a Skullcap (*Scutellaria Bushii*), a False Gromwell (*Onosmodium subsetosum*), species of Beard-tongue (*Penstemon Cobaea* var. *purpureus* and *P. arkansanus*), Feverfew (*Parthenium hispidum*) are examples. Mingled with the Ozark glade flora are many species typical of the prairies, including the following: Blue-stem (*Andropogon scoparius* and *A. Gerardi*), Indian Grass (*Sorghastrum nutans*), Wild Hyacinth (*Camassia scilloides*), Puccoon (*Lithospermum canescens*), Prairie Parsley (*Polytaenia Nuttallii*), Downy Gentian (*Gentiana puberula*), Wild Indigo (*Baptisia leucantha*), Stiff Goldenrod (*Solidago rigida*), Blazing Star (*Liatris scabra*), Feverfew (*Parthenium integrifolium*), Rosinweed (*Silphium laciniatum*), Purple Coneflower (*Echinacea pallida*), Coreopsis (*Coreopsis palmata*), and Prairie Clover (*Petalostemum purpureum*).

Characteristic species of limestone "glades" include the following:

Ophioglossum Engelmanni
Juniperus virginiana
Carex Meadii
Allium stellatum
Nemastylis geminiflora
Agave virginica
Arenaria patula
Talinum calycinum
Clematis Fremontii var. *Riehlii*
Leavenworthia uniflora
Delphinium Treleasei
Sedum pulchellum
Acacia angustissima var. *hirta*
Baptisia minor
Berchemia scandens
Oenothera missouriensis
Stenosiphon linifolius
Evolvulus Nuttallianus
Scutellaria Bushii
Satureja arkansana
Amsonia ciliata var. *filifolia*
Penstemon Cobaea var. *purpureus*
Heliotropium tenellum
Centaurium texense
Hymenopappus scabiosaeus
Echinacea paradoxa
Solidago Gattingeri
Aster sericeus
Aster oblongifolius
Palafoxia callosa
Rudbeckia missouriensis
Coreopsis lanceolata



Map of Missouri, showing areas of botanical in
Drawn by Douglas E. Tibbitts, Staff Artist, Chic



zark region.
story Museum.

In contrast to the flora occupying the calcareous outcrops and substrata, some of the characteristic species found on the acid soils underlain by the sandstone, granite-porphyry, and chert rocks, and especially where the soil cover is thin, are:

Selaginella rupestris
Lycopodium lucidulum
Pinus echinata
Agrostis Elliottiana
Andropogon Elliottii
Andropogon ternarius
Vulpia octoflora and vars.
Panicum sphaerocarpon and many other species
Luzula campestris var. *bulbosa*
Hypoxis hirsuta
Carya texana
Quercus coccinea
Quercus falcata
Polygonum tenue
Tradescantia longipes
Ranunculus Harveyi
Tephrosia virginiana
Clitoria mariana
Lespedeza hirta
Lespedeza repens
Desmodium nudiflorum
Desmodium ciliare
Desmodium rotundifolium
Crotonopsis elliptica
Acer rubrum
Lechea tenuifolia
Viola pallens
Hypericum gentianoides
Oenothera linifolia
Nyssa sylvatica var. *caroliniana*
Rhododendron roseum
Vaccinium arboreum var. *glaucescens*
Vaccinium vacillans var. *crinitum*
Vaccinium stamineum and var. *neglectum*
Mitchella repens
Diodia teres
Houstonia longifolia
Houstonia pusilla
Galium arkansanum
Lonicera flava
Solidago hispida
Aster linariifolius
Krigia Dandelion

The lithological character of the soil is the principal factor which influences the particular type of forest encountered. Thus, the native Shortleaf Pine *(Pinus echinata)*, certain oaks *(Quercus coccinea, Q. falcata, Q. marilandica, Q. stellata)*, hickories *(Carya texana)*, Red Maple *(Acer rubrum)*, and Sour Gum *(Nyssa sylvatica* var. *caroliniana)* are characteristic of sandstone, granite-porphyry, and chert outcrops, or of soils derived from them, and are dominant species of such forests. Sugar Maple *(Acer saccharum)*, Chestnut Oak *(Quercus Muhlenbergii)* and Blue Ash *(Fraxinus quadrangulata)* are plants of calcareous soils. Each of these forests has, of course, a diversified number of shrubs and herbaceous plants commonly associated with them. On the calcareous soils of the *Acer saccharum* forest are found *Hepatica acutiloba*, Redbud *(Cercis canadensis)*, Yellow Wood *(Cladrastis lutea)*, American Bladdernut *(Staphylea trifolia)*, Ginseng *(Panax quinquefolius)*, Chittim Wood *(Bumelia lanuginosa)*, Black Haw *(Viburnum rufidulum)*, and Leafcup *(Polymnia canadensis)*. In a pine-oak-hickory or oak-hickory forest are to be seen such plants as Saw Brier *(Smilax glauca* var. *leurophylla)*, species of Blueberry *(Vaccinium vacillans* var. *crinitum)* and Farkleberry *(Vaccinium arboreum* var. *glaucescens)*, Dittany *(Cunila origanoides)*, Horsemint *(Monarda Bradburiana)*, and False Foxglove *(Gerardia grandiflora* var. *cinerea, G. calycosa,* and *G. pectinata)*.

AQUATIC HABITATS

The Ozarks have been in part continuously free of glaciers and above sea level since the end of the Paleozoic era, millions of years ago. Between Paleozoic and Tertiary times the Ozark area was worn down at least twice to a level peneplain, but each time subsequently was uplifted into a hilly rocky land mass. After the last uplift, in late Tertiary times, the once low-lying swampy peneplain become a high and dry rocky plateau. The aquatic habitats that remained after this uplift were streams, springs, sloughs and swamps in valleys, and upland natural ponds.

Springs.—One of the spectacular features in the Ozarks are the numerous large springs. Being surface outlets of underground streams, their summer temperatures are cooler (52°–60° F.) than the streams into which they flow, and they harbor a number of species not found in the warmer streams. The flora of the springs is generally similar, but in no two springs is it exactly the same. Such factors as depth and swiftness of the water and type of substratum (mud, sand, gravel, rocks, or a combination of these) influence the distribution and abundance of species. Water Cress *(Nasturtium officinale)* is a characteristic and apparently indigenous inhabitant of springs. Two other flowering plants commonly associated with Water Cress are Water Milfoil *(Myriophyllum heterophyllum)* and Water Starwort *(Callitriche heterophylla)*. Besides these, the following are commonly encountered: Bur-reed *(Sparganium americanum)*, Water-weed *(Elodea Nuttallii)*, Horned Pondweed *(Zannichellia palustris)*, Pondweeds *(Potamogeton amplifolius, P. illinoensis* and *P. foliosus* var. *gemmins)*, White Water Crowfoot *(Ranunculus longirostris)*, Hornwort *(Ceratophyllum demersum)*, Water Purslane *(Ludwigia palustris* var. *americana)*, and Water Speedwell *(Veronica comosa)*. A rare plant of springs is the Ivy-leaved Duckweed *(Lemna trisulca)*. Altogether, 33 different species of flowering plants have been collected from the various Missouri springs.

Streams.—Plants characteristic of large Ozark streams are Eel Grass *(Vallisneria americana)*, Pondweed *(Potamogeton nodosus* and *P. pectinatus)*, Water Star-grass *(Heteranthera dubia)*, Yellow Water Crowfoot *(Ranunculus flabellaris)*, Bladderwort *(Utricularia vulgaris)*, and Water Willow *(Justicia americana)*.

Natural Upland Ponds.—It is somewhat of a surprise to encounter on top of a dry oak-hickory ridge or level upland plateau a natural pond. Known as "sink-hole ponds" because of their association with sink-holes and underground drainage, they occur only in the southern part of the Missouri Ozarks, most often in Dent, Shannon, Reynolds, Carter, Oregon and Howell counties. They are habitats for a number of aquatic species found nowhere else in the

Pond in Oregon County, in which Buttonbush (Cephalanthus) is dominant.

state. Many of the species growing in these ponds occur only on the Gulf or Atlantic Coastal Plain or up the Mississippi Embayment. *Scirpus etuberculatus*, which is isolated in the Ozarks in a sink-hole pond in Oregon County, occurs elsewhere from Delaware along the coastal area and slightly inland to Florida and Louisiana. Other Gulf or Atlantic Coastal Plain species found in these upland ponds are *Eleocharis equisetoides*, Water Millet *(Zizaniopsis miliacea)*, Buttonbush *(Cephalanthus occidentalis* var. *pubescens)*, *Eryngium prostratum*, and Water Tupelo *(Nyssa aquatica)*. Burhead *(Echinodorus tenellus)*, one of the pondweeds *(Potamogeton epihydrus* var. *Nuttallii)*, Naiad *(Najas gracillima)*, various species of Bulrush *(Scirpus Hallii* and S. *Torreyi)*, and Swamp Loosestrife *(Decodon verticillatus)* are known in Missouri only from sink-hole ponds. Other species characteristic of these ponds are *Potamogeton pulcher*, several carices *(Carex decomposita* and *C. alata)*, Three-way Sedge *(Dulichium arundinaceum)*, Manna-grass *(Glyceria acutiflora)*, Rose-mallow *(Hibiscus lasiocarpus)*, Mermaid-weed *(Proserpinaca palustris)*, and Featherfoil *(Hottonia inflata)*.

Swampy meadows.—Swampy or wet meadows are important aquatic habitats in the comparatively dry Ozark region. These occupy usually level ground along the smaller streams, and are associated with calcareous soil constantly moistened by spring seepage. In such habitats, mostly in the

southeastern Ozarks, but extending westward in the state to Johnson, Pettis, and Benton counties, a number of swamp-loving species have survived. Here are to be found a variety of sedges (Dulichium, Scleria, Fimbristylis, Carex), and rushes (*Juncus* spp.), Grass-of-Parnassus (*Parnassia grandifolia*), Fireweed (*Epilobium coloratum*), Lousewort (*Pedicularis lanceolata*), Loosestrife (*Lysimachia hybrida* and *L. quadriflora*), Phlox (*Phlox maculata* and *P. glaberrima*), and Coneflower (*Rudbeckia umbrosa*), associated with such woody plants as Willow (*Salix sericea*), Alder (*Alnus serrulata*), Swamp Rose (*Rosa palustris*), and Buttonbush (*Cephalanthus occidentalis*). Some northern species which are known in the state only from these meadows are Rose Pogonia (*Pogonia ophioglossoides*), Loesel's Twayblade (*Liparis Loeselii*), species of Carex (*Carex suberecta* and *C. Woodii*), Violet (*Viola cucullata*), Bogbean (*Menyanthes trifoliata* var. *minor*), Bellflower (*Campanula aparinoides*), and Aster (*Aster puniceus* var. *firmus* f. *lucidulus*).

RELICTS AND OTHER ISOLATED PLANTS

During the Ice Age northern species migrated southward into the Ozarks and survived in certain habitats. As the ice sheet retreated, these species were stranded, but under much warmer climatic conditions than those to which they had been accustomed farther north. Many of them failed to survive. A few managed to hold on to these sheltered canyons and bluffs where we now find them as relicts. In most instances, such plants are not spreading or increasing their range; rather are they on the wane.

Two especially good areas of relict populations in the Ozarks are "Pickle Springs" and "Jam-up Bluff." The former is in a region of Lamotte sandstone of Cambrian age, the latter on Gasconade limestone topped by Roubidoux sandstone of Ordovician age.

At Pickle Springs the narrow moist sheltered canyons offer a retreat for the rare moss, *Bryoziphium norvegicum*, its only known station in Missouri, for *Sphagnum compactum*, clubmosses (*Lycopodium complanatum* var. *flabelliforme*, *L. lucidulum*, *L. porophilum*), Hayscented Fern (*Dennstaedtia punctilobula*), many other species of ferns, Rattlesnake Plantain (*Goodyera pubescens*), Violet (*Viola pallens*), Azalea (*Rhododendron roseum*), and Partridgeberry (*Mitchella repens*). A magnificent pine forest (*Pinus echinata*) covers the entire area, but is especially well developed on the rocky exposures and thinner soils. Red Maple and Sour Gum are common in the ravines with an understory of species of Blueberry (*Vaccinium vacillans* var. *crinitum*), Farkleberry (*Vaccinium arboreum* var. *glaucescens*), and Deerberry (*Vaccinium stamineum* and var. *neglectum*). On the moist sandstone bluffs saxifrages (*Saxifraga virginiensis* and *S. pensylvanica*) are common, while on the dry exposed glades above are *Selaginella rupestris*, *Agrostis Elliottiana*, Beard Grass (*Andropogon Elliottii*, *A. ternarius*), *Polygonum*

tenue, Pineweed *(Hypericum gentianoides)*, Sundrops *(Oenothera linifolia)*, Dwarf Dandelion *(Krigia virginica* and *K. Dandelion)*. Such species as *Bryoziphium norvegicum*, *Lycopodium complanatum* var. *flabelliforme*, *Dennstaedtia punctilobula*, *Goodyera pubescens*, *Viola pallens*, and *Rhododendron roseum* are undoubtedly survivors of a more northerly flora that had penetrated south into this region at the time of the Pleistocene ice advance.

The same situation is encountered at Jam-up Bluff. Here, in a remote section of the Ozarks in Shannon County, isolated at their southernmost or southwesternmost limits of dispersal, are such northern species as the Bulrush *(Scirpus verecundus)*, White Camass *(Zigadenus elegans)*, Northern Bedstraw *(Galium boreale* var. *hyssopifolium)*, and Harebell *(Campanula rotundifolia)*. These are associated with a floral element found in the southern Appalachians, such as False Bugbane *(Trautvetteria caroliniensis)*, Barberry *(Berberis canadensis)*, and Grass-of-Parnassus *(Parnassia grandifolia)*. The species of northern affinities are apparently relicts of the Ice Age, during which time they migrated southward and, with the retreat of the ice sheet, have since become stranded in their present habitats. These north-facing cool moist bluffs on which relict species now persist represent and offer the nearest approach to conditions represented in more northern climates. But, as with the plants at Pickle Springs, surrounded by adverse ecological conditions and with few similar spots to offer a haven, relict species are not increasing or spreading. Such plants and their habitats are in great need of receiving permanent protection.

AREAS OF UNUSUAL BOTANICAL INTEREST

Many localities of the Ozarks and adjacent portions of the state possess unique plant communities, among which the following should be mentioned: bluffs along the White River in Stone County, the only station known for Wooly Lip Fern *(Cheilanthes lanosa,* previously known as *C. tomentosa)*; a station in Carter County for Clinton's Wood Fern *(Dryopteris cristata* var. *Clintoniana)*; an area of sandstone in Jasper County, the only known station in the world for the dwarf *Geocarpon minimum*; an area of saline soils near Elk Lick Springs in Saline County dominated by the Spikegrass *(Distichlis spicata)*, otherwise limited to saline soils and marshes along and near the coast of the United States and adjacent Canada; Oregon County, locality for Death-Camass *(Zigadenus Nuttallii)*, Umbrella-plant *(Eriogonum longifolium)*, and Blazing Star *(Liatris spicata)*; and Bollinger County, where Small Whorled Pogonia *(Isotria medeoloides)* is found. Numerous species are known in the state from but one station. A few of these may eventually be found elsewhere, but the great majority are restricted in their distribution because similar habitats are unavailable or because only a few individual plants have survived at a particular locality.

NUNATAK OZARK LOCALITIES

Bordering the Missouri River on the north and continuing north along the western side of the Mississippi River is hilly broken country with chert, sandstone, and limestone outcrops weathering into bluffs and "glades." This region may be considered botanically, if not also geologically, as part of the Ozarks. In certain portions of it occur what may be considered "nunatak"[1] areas, which, having escaped being covered by the last Pleistocene ice sheets, have preserved their original flora. One such locality is in Lincoln County in an area of St. Peter sandstone. Here occur plants known to grow elsewhere in this state only south of the Missouri River in the Ozark region or confined to the Ozark area north of the Missouri River. Such plants are Clubmoss *(Lycopodium lucidulum)*, Marginal Shield Fern *(Dryopteris marginalis)*, Farkleberry *(Vaccinium arboreum* var. *glaucescens)*, Blueberry *(Vaccinium vacillans* var. *crinitum)*, and Partridge-berry *(Mitchella repens)*. In another part of this county, on a limestone glade, occurs Rock-moss *(Sedum pulchellum)*, otherwise confined to unglaciated territory to the south. Finally, in Marion County, along the bluffs of the Mississippi River near Hannibal, is the rare species of Shooting Star *(Dodecatheon amethystinum)*, known otherwise only from the "Driftless Area" to the north and unglaciated territory to the east of Missouri. Throughout the region bordering the Missouri River on the north and the Mississippi River between St. Charles and Hannibal and slightly northward and westward, many species occur which are known elsewhere in Missouri only from the Ozark region. Among these may be mentioned: Marginal Shield Fern *(Dryopteris marginalis)*, Clubmoss *(Lycopodium lucidulum)*, Saxifrage *(Saxifraga pensylvanica)*, Bishop's Cap *(Mitella diphylla)*, Sullivantia *(Sullivantia renifolia)*, Red Maple *(Acer rubrum)*, Chittim-wood *(Bumelia lanuginosa)*, Black Haw *(Viburnum rufidulum)*, Fire-pink *(Silene virginica)*, Phlox *(Phlox paniculata)*, Phacelia *(Phacelia bipinnatifida)*, *Evolvulus Nuttallianus*, Dutchman's-pipe *(Aristolochia tomentosa)*, Carolina Buckthorn *(Rhamnus caroliniana)*, Flowering Dogwood *(Cornus florida)*, Sassafras *(Sassafras albidum)*, and Goldenrod *(Solidago hispida)*.

[1] *Nunatak* is an insular hill or mountain surrounded by an ice sheet.

One of the strangest of the Ozark endemics is *Clematis Fremontii* var. *Riehlii*, the Leather-flower. No botanist seeing its leaves for the first time would ever suspect that these tough, almost woodenly rigid appendages, solidly set on a short stiff stem, are those of a Clematis.

FERNS OF THE MISSOURI OZARK REGION

ROLLA M. TRYON, JR.

The Missouri Ozarks are rich in species of ferns in comparison with adjacent areas. The number of species is due not only to a considerable variety of available habitats but, at the present time, just as much to the relatively unspoiled condition of the land. The natural vegetation has not been destroyed and modified to the same extent as in areas where farming is more profitable. In general, the habitats that are sufficiently moist the year around to support a considerable variety of species are fewer than in the states to the northeast and correspondingly more numerous than in the region to the southwest. No species are peculiar to the Ozarks although some, such as *Ophioglossum Engelmanni*, *Isoetes Butleri*, and *Adiantum Capillus-Veneris*, are characteristic of the region and grow particularly luxuriantly there. A number of the Ozark species are generally distributed in North America; many are characteristic of northeastern North America; and others of the southwestern United States.

The principal habitats of the Ozark ferns are rich wooded ravines, wooded rocky slopes, shaded bluffs, and moist cliffs. Such habitats afford moisture in midsummer and rich undisturbed soil or suitable rock crevices. Especially suitable localities may harbor twenty or more species. Exposed cliffs and upland rocky woods provide suitable conditions for a few species; others have individual preferences and nearly always grow by themselves.

Some species, such as *Polystichum acrostichoides* and *Adiantum pedatum*, grow under very much the same conditions in the Ozarks as elsewhere in their range, while others are restricted to quite different habitats. For example, *Dennstaedtia punctilobula*, the Hayscented Fern, grows in many types of habitats in the Northeastern States including pastures and mowing fields. In the Ozarks it is very local and confined to sandstone ledges. Two species of *Osmunda*, *O. regalis*, the Royal Fern, and *O. cinnamomea*, the Cinnamon Fern, are characteristic of swampy and low rich woods, marsh borders, stream banks, and bogs in the states to the northeast where they are among the commoner ferns, while in the Ozarks both grow in crevices of rocks where there is local moisture. It is surprising for a visitor to see these species growing as cliff-plants.

Among the commoner species that will be encountered on any trip to the Ozark region are *Adiantum pedatum*, Maidenhair Fern, and *Botrychium virginianum*, Rattlesnake Fern, both of which grow in rich leaf-mold in undisturbed woods. *Polystichum acrostichoides*, Christmas Fern, is less restricted in its preferences and will do just as well on rocky slopes and in more

open woods. *Dryopteris marginalis* grows particularly well on rich rocky slopes. It is perhaps more attractive when it grows on ledges and in crevices of cliffs although there it is of a smaller size. *Athyrium asplenioides*, the Lady Fern, forms large colonies on damp wooded slopes or in rich stream bottoms. In thickets and in open woods, particularly where there is rocky soil, *Cystopteris fragilis*, *Asplenium platyneuron* (Ebony Fern), and *Woodsia obtusa* are likely to be found. All three will grow as well on rocky ledges, the Cystopteris usually on the damper rocks, and the other two on drier ones. On calcareous rocks that are fairly moist *Cystopteris bulbifera* often grows in profusion and the two cliff-brakes, *Pellaea atropurpurea* and *P. glabella*, usually grow higher up the cliff in the drier situations. On the driest rocks small plants of *Cheilanthes Feei* may be found. In the eastern part of the Ozarks the common Polypodium of the eastern states *(P. virginianum)* grows on ledges and in crevices of acid rocks. In clay and alluvium along stream banks, *Equisetum hyemale*, the Scouring Rush, forms large thickets.

Other species that may be encountered are of more especial interest than the more or less ubiquitous ones just mentioned. Near some of the large springs and by streams the lower branches and decumbent trunks of trees may be covered by *Polypodium polypodioides*, the Resurrection Fern. In dry weather it is hardly noticeable on the trees but after a rain it clothes their branches with green. However, it will be more commonly found growing on dry sandstone ledges than as an epiphyte. Two notable species grow on moist or wet calcareous rocks: *Camptosorus rhizophyllus* (the Walking Fern) and *Adiantum Capillus-Veneris* (the Venus'-hair Fern). The Walking Fern is the more common, and it is always of interest because of the variations of its simple leaf and its unusual method of vegetative reproduction. The long-attenuate leaf tip develops a bud, and this strikes root when the tip comes in contact with the moist soil. The Venus'-hair Fern is the most attractive fern of the region, its pendent fronds clothing the ledges in favorable localities. The base of limestone cliffs that have been undercut by a stream seems to be its preferred habitat. On sandstone or other acid rocks there are two rare spleenworts, *Asplenium pinnatifidum* and *A. Bradleyi*. Both are local and grow well only in certain micro-habitats. *Selaginella rupestris* also grows on acid rocks but on flat ledges in dry sunny situations. A mat of Selaginella looks very much like a coarse moss but the square strobili will serve to identify it. A local fern but one that is widely distributed and usually abundant where it does occur is *Ophioglossum Engelmanni*, the Adder's-tongue. It grows on glades and in rather open woods in clay or cherty soil. Late spring and early summer are the best times to look for it because it is one of the earliest ferns to come up and dies down before midsummer. The quillwort *(Isoetes Butleri)* also grows on glades and on limestone barrens

that are very wet in the spring. It is not easy to find, for it too dies down early in the season and in addition it is we'l camouflaged by the turf in which it grows.

Several papers have been published that provide an excellent introduction to the ferns of Missouri. Interested readers may refer to them for additional and more detailed information.

Chandler, A. The commoner Missouri ferns. Garden Life 14:6–8. 1941.

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Palmer, E. J., and J. A. Steyermark. Additional fern records from Missouri. Amer. Fern Jour. 25:1–5. 1935.

Pinkerton, M. E. Ferns and fern allies of Missouri. Ann. Mo. Bot. Gard. 20:45–78. 1933.

The Missouri Primrose comes into its own in June. The plant is so low and inconspicuous that until its buds open up one can literally walk over the plant without seeing it. When it is in flower, its pale sulphur-yellow corolla, the size of a salad plate, is something to remember. It is beautiful in the early morning and late evening, though, like the Taj Mahal, it has a certain ethereal beauty when seen by the light of the full moon.

Common and conspicuous plants deserve good common names so that they can be recognized and made a part of our indigenous American culture. A most appropriate common name has begun to take hold in the St. Louis area for *Blephilia ciliata*. This lavender-flowered mint is one of the commonest roadside blooms in the northern Ozarks during the month of June. The flowers are borne along the stem in dense clusters, somewhat as in some kinds of Monarda, and the common name "Pagoda Mint" seems particularly appropriate.

In Missouri the limestone and dolomite glades are conspicuous because they have no trees, and one finds himself thinking of them as relicts of a time when the prairies covered wider areas than they do at present. A careful study of the plants which grow on our glades shows that many of them, if they occur in the prairies and plains at all, do so only in very peculiar rocky cuestas. In central Oklahoma, in a treeless region, one can find glades here and there on rocky outcrops which are virtually the same kind of habitat and have many of the same species as do the Missouri glades. They are not so conspicuous there as here since they are set in a treeless landscape. It is probable, as a matter of fact, that some of the distinctive species of the Missouri glades are part of a very ancient mid-Continental flora, some species of which spread out onto the prairies and plains when these came into being.

NOTES

Volume XXXVIII, Number 2, of the ANNALS OF THE MISSOURI BOTANICAL GARDEN was recently issued, with contents as follows: Biography of Dr. J. M. Greenman, by Robert E. Woodson, Jr.; Chromosome Numbers of Californian Delphiniums and their Geographical Occurrence, by Harlan Lewis, Carl Epling, Gustav A. L. Mehlquist, and C. A. Wyckoff; Studies in Apocynaceae. VIII, by Robert E. Woodson, Jr.

A recent visitor at the Garden was Sven Andersen, of Denmark, who is in the United States, collaborating with Dr. Stanley Cain of the University of Michigan in producing an atlas of the pollens of Europe and North America. Mr. Andersen worked several days in the herbarium, obtaining pollen for examination, and lectured to the seminar of the Henry Shaw School of Botany. Other recent visitors include: Mr. James D. Ray, graduate student in botany, University of Illinois; Dr. R. E. Shanks, Mr. Frank Barkley, Mr. and Mrs. Frank Woods, and Mr. James Harden, of the department of botany, University of Tennessee, Knoxville; Dr. M. Trufant Hall, of Cranbrook Institute, Bloomfield Hills, Mich.; and a group of botany students from Greenville College, accompanied by their teacher, Mr. John H. Ayers, who is a graduate student at the Garden.

The graduate students in the Henry Shaw School of Botany who received their Doctor's degrees at the Washington University commencement are scattering to various parts of the world. Dr. Reino O. Alava is returning to Finland, where he has received an appointment in the University of Turku and in the Turku Botanical Garden. Dr. David J. Rodgers is going to Allegheny College, Meadville, Pa., as Assistant Professor of Botany. Dr. Donald N. Duvick has been made a member of the Breeding Department of the Pioneer Hi-Bred Corn Co., at Johnston, Iowa, where two of his colleagues, Dr. William L. Brown and Mr. Stanley Bettoney, have advanced degrees from the Shaw School of Botany. Dr. M. Trufant Hall has already moved to the Cranbrook Institute of Science, at Bloomfield Hills, Mich., where he succeeds Dr. Stanley Cain. Dr. Hall will also have an honorary appointment at the University of Michigan at Ann Arbor. Dr. Harrison A. Hoffman will continue on the staff at the Anheuser-Busch Brewing Assn. in St. Louis, as Chief Bacteriologist.

During the spring, work has gone forward on the Wild Flower Trail at the Arboretum at Gray Summit, which has been sponsored by the Garden Club of St. Louis. The trail across the long glade, which was widened last

summer, has now been extended to reach the limestone cliffs above the Meramec River. At this point there are a series of natural rock gardens in little coves along the face of the cliff. On the talus slopes beneath is a splendid display of early spring wild flowers. By digging out the broken rock at the top of the talus slope and building up a path from one cove to another it has been possible to make this beautiful spot available to non-athletic visitors. Early displays of bloodroot, Dutchman's Breeches, and other spring wild flowers are followed by masses of Miami Mist *(Phacelia Purshii)* and Woollen Breeches *(Hydrophyllum appendiculatum)*. There are rare ferns in the clefts in the rock, and the area is attractive throughout the year. It is a south slope, so that early in spring it is flooded with sunshine and is a pleasant place to rest when other parts of the Arboretum are raw and windy. Because it is so sheltered some of the earliest wild flowers bloom here before they open in more exposed places. First come the tiny "Harbingers of Spring" *(Erigenia bulbosa)*, then the Bloodroot and a host of common spring wild flowers. One of the loveliest of these is the Wild Hyacinth, *Camassia scilloides*, which is more variable in form and color and size in the Ozarks than it is to the east and north.

When late spring brings the trees into leaf these little limestone coves pass from being one of the warmest places in the Arboretum to one of the coolest. Not only are they in the shade, but the overhanging limestone is almost cave-like in keeping out the heat, and they are a pleasant place to rest after tramping across the limestone glades in the blazing sunshine. When all the springtime bloom has passed, vines hang down across the face of the cliff, and the green tracery of their leafage makes an interesting pattern against the gray limestone. On the talus slopes one of the strange grasses of the Ozarks, *Diarrhena americana*, grows in lush strands, 2–3 feet high and many square yards in extent. It was one of the primitive foods of the Indians, and one who cares to do so may with patience gather enough of its seeds (which are rather like wild rice) to stuff the Thanksgiving turkey.

THE MISSOURI BOTANICAL GARDEN

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SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 50,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

MISSOURI BOTANICAL GARDEN BULLETIN

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Lawn Establishment and Care

Volume XXXIX September, 1951 Number 7

Cover: Winter Wheat (right) and Annual Rye (left) as quick covers for an area to be reseeded later to permanent turf. (Photograph by Robert W. Schery.)

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Missouri Botanical Garden Bulletin

Vol. XXXIX SEPTEMBER, 1951 No. 7

LAWN ESTABLISHMENT AND CARE

ROBERT W. SCHERY

At the onset of autumn, after a full course of spring and summer weeds and mowing, the home-owner may look with relief toward hoped-for slack times in the offing. Yet, for the establishment or improvement of the lawn no time is more appropriate and critical in our area than is early September. Ahead are cool nights and bright days, adequate and usually gentle rains, workable soils, petering-out of weed competition, and not quite so much pressure for other gardening tasks. Add to these factors the inherent habit of our major grass, bluegrass, to germinate seed and establish robust rosette growth well into winter, and one has ingredients crying for immediate action on the lawn front. Yes, September in St. Louis is the time to prepare for next summer's increased pleasure and lessened maintenance of the lawn.

Many books (mostly for the northeastern United States) and not a few articles have been devoted to lawn problems. Nevertheless, it seems appropriate in this mid-century to review the over-all strategy in lawn establishment and care in the St. Louis area. The reader will perhaps note a gradual fading of certain older methods, as lawn management, following agriculture, adopts mechanization and labor-saving techniques. By way of example, selective chemical control of plant growth, although a phase of plant science still in its early youth, is now definitely accepted in the lawn-care program, supplementing hand weeding, and gives promise of greater things to come.

An article of BULLETIN length cannot ramify into discussions of the many types of lawns possible and their especial care. Instead, I will emphasize the one type of lawn that most discriminating people find practical yet of fine quality for this region—one in which Kentucky Bluegrass eventually predominates. If the home-owner would rather develop a creeping bent (golf-green type needing repeated top-dressing), hardy Bermuda (U-3 strain, propagated vegetatively only), or some other special type lawn, he had best

seek advice from greens-keepers, experiment stations, or experienced dealers, and browse through the several books that elaborate upon turf subjects.[1]

TYPES OF LAWN MUST FIT THE CLIMATE

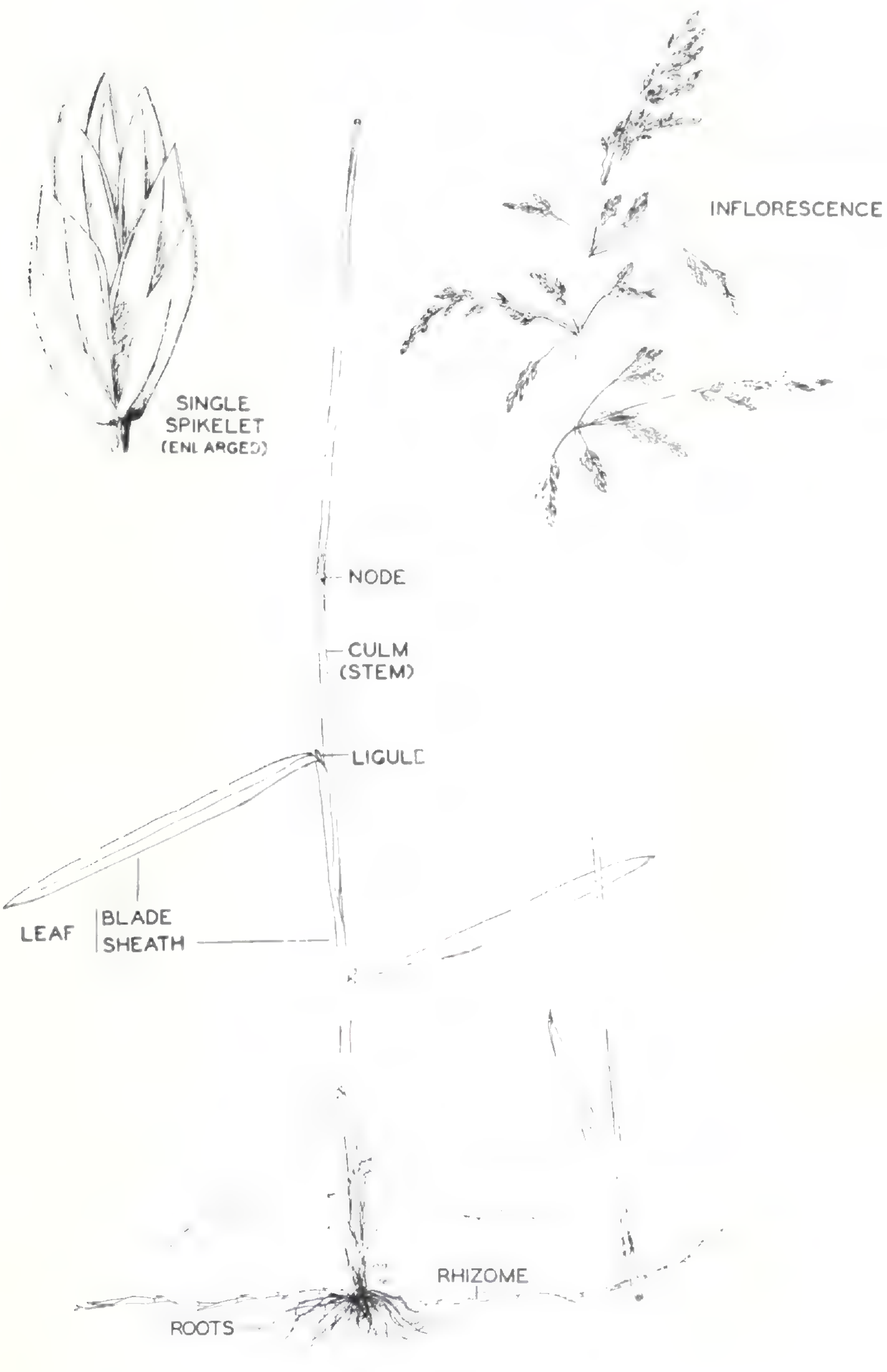
The position of St. Louis in the climatic zones of the nation is a difficult one for lawns—not completely South (although we can grow certain Bermudas and Zoysia), nor North (our warmer and often drier summers inhibit certain desirable grass strains), nor East (ordinarily with more abundant and better distributed summer rainfall than St. Louis), nor West (we are east of the drier prairie grass region). Our affinities are most with the Northeast in vegetational type and lawn components, but we are just sufficiently far west and south to make conditions rather trying at times for seed mixtures and strains developed primarily, say, for New England. Nevertheless, the bluegrass-dominated lawn is basically the same as for the northeastern section of the nation. And if the climatic cycle of the several rather moist and comparatively cool summers past were to continue, we could practically embrace lawn types and techniques used in the Northeast (or Pacific Northwest).

THE LAWN COMMUNITY

In the perpetual conquering of bare soil by vegetation, many plant species become components of the lawn under any given set of environmental circumstances. Even diligently tended lawns, with controlled conditions favorable to Kentucky Bluegrass and appearing almost solidly this grass, show occasional scattered interlopers such as plantain, dandelion, crabgrass, redtop, nimblewill, and other weeds. If conditions are altered to disfavor bluegrass, such as improper mowing, inadequate fertilizing, etc., one or more of the "weeds" might tend to spread and thrive at the expense of the bluegrass. In nature, there is ever a constant competition for all available space and nutriment.

Under the climatic conditions prevailing in the northeastern section of our country, Kentucky Bluegrass, actually an immigrant from Europe, tends in time to gain at least a pretty stout foothold in the lawn even when no pains are taken to establish it there. If we concede that, of all members of the lawn community, bluegrass will make the most practical turf, it behooves us to make conditions as near to the liking of bluegrass as is possible, and these will almost automatically be to the disadvantage of competitors (unwanted grasses and other weeds). As "dictator" over his lawn community, the home-owner can choose his favorite subject, and he has the power to

[1]One of the more recent is "Turf Management," by H. B. Musser, publication of the United States Golf Association, McGraw-Hill, 1950. The book is primarily concerned with golf-course turf, but by implication offers considerable information about home lawns.



Kentucky Bluegrass, showing the various parts of the plant.

adjust community conditions, the "economic and political atmosphere" of the lawn if you will, to the advantage of his favorite. In order to understand how bluegrass may be favored in lawn community life, it is necessary to examine briefly the yearly cycle of activity of the members of the community. One can't free a community of hoodlums until one knows what a hoodlum is and does, and at what season policemen, as well as hoodlums, are likely to take a vacation.

IMPORTANT SPECIES IN THE LAWN COMMUNITY

Even the rank amateur among us likely can distinguish dandelion, clover, and "grass" in the lawn, but one need not feel dismayed if most grasses in the lawn look alike to him; even the expert would probably need a microscope and special books to give an accurate identification of the grass, and he might want it in flower. A few key characteristics can serve to indicate the important grasses, and with familiarity acquired through observing the lawn through an entire year one begins to recognize grasses by their time of appearance, shade of color, response to mowing, and by various seemingly intangible characteristics. Some of the more familiar kinds of lawn plants found in St. Louis lawns are briefly described below.

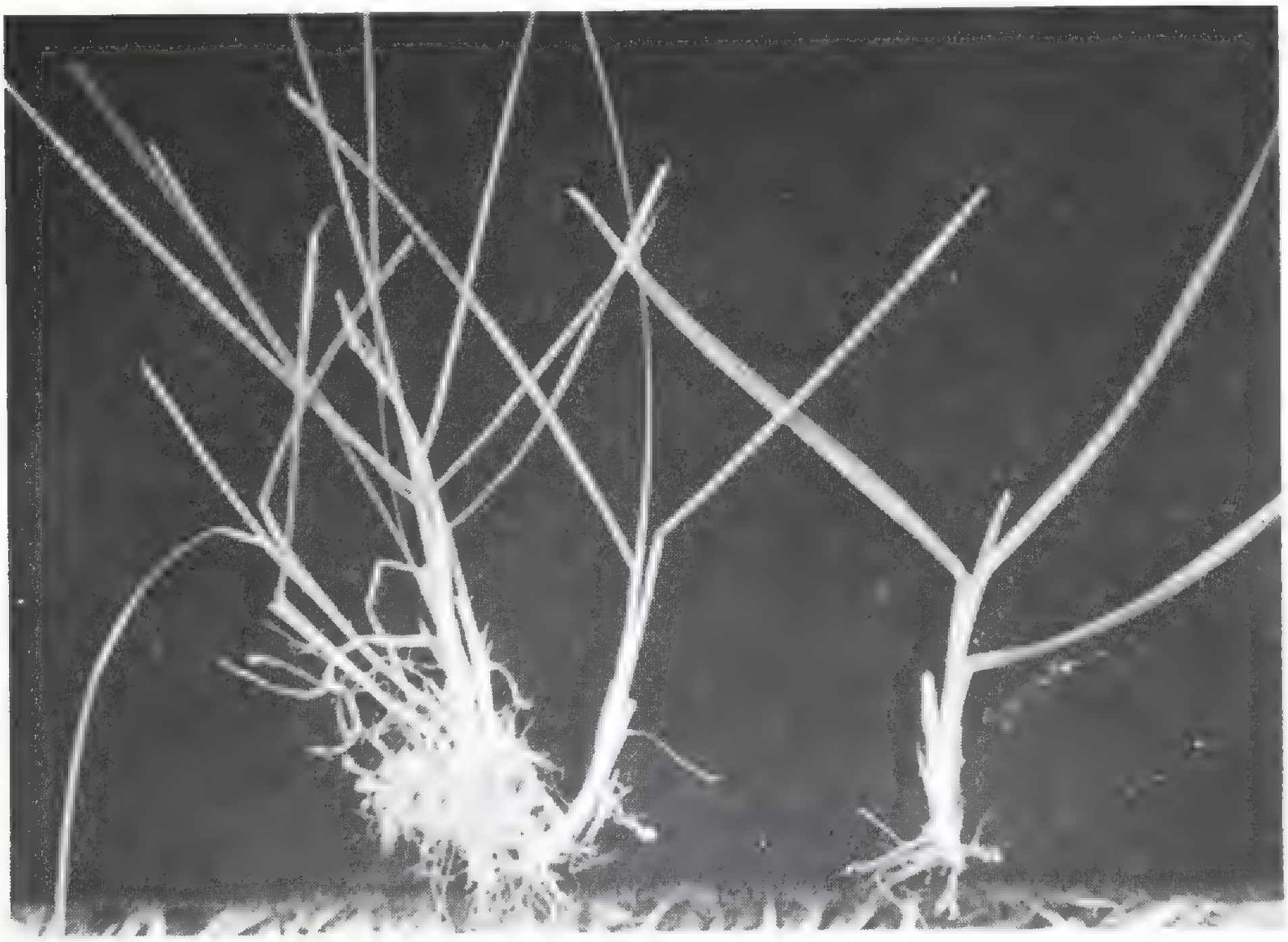
Grasses (Gramineae)

The Bluegrasses (Poa).—

Leaves with a boat-shape or spoon-like tip (easily felt in running the leaf between thumb and finger), narrow and slender compared to crabgrass, foxtail, and redtop, but typically slightly broader than thread-like fescue leaves; in cross-section leaves folded in bud, not rolled as with the Bents.

Kentucky Bluegrass (Poa pratensis).—Familiar component of lawn-seed mixtures, quite variable and with narrow or broadleaf strains; perennial, spreading by underground stems, generally with a bluish-green cast (crabgrass or annual rye lighter or yellowish-green); leafy stems erect and not low-spreading as those of crabgrass. Vigorous growth starts in March, with flowering and seeding in middle and late spring; semi-dormant and often browning in summer if weather hot and dry; compact vigorous growth again in autumn with cool weather and rains, lasting (green) well into winter (December-January).

Annual Bluegrass (Poa annua).—Smaller than preceding and with light green fine foliage; in dense tufts very early in spring; in flower weeks before Kentucky Bluegrass and dies in summer after setting seed; annual, the seed germinating and making preliminary growth in autumn; generally undesirable in lawns because area left bare to crabgrass and weeds late spring and summer.



Narrow- and broad-leaf strains of native bluegrass

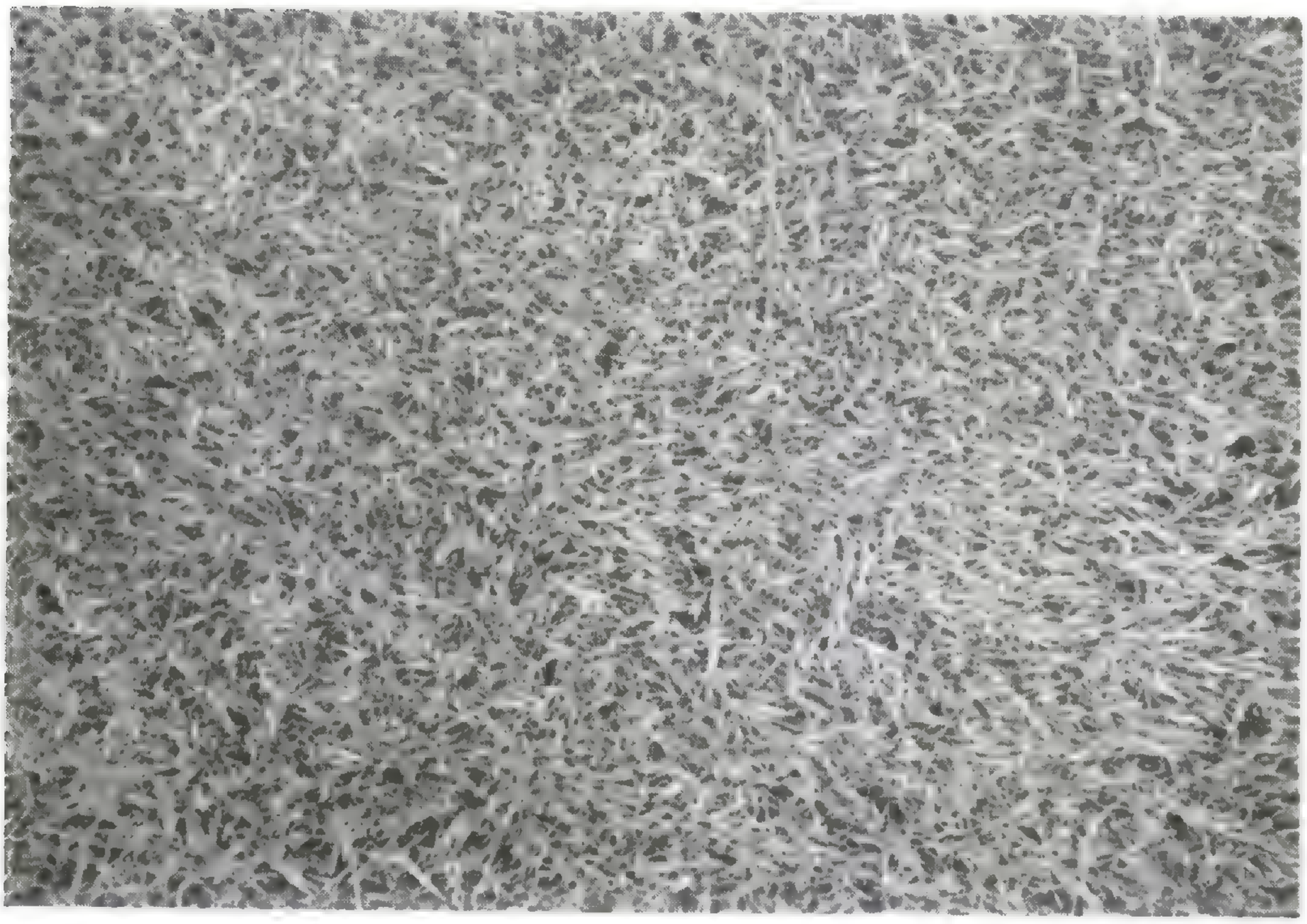
Canada Bluegrass (Poa compressa).—Similar to Kentucky Bluegrass except somewhat coarser, darker blue-green, the stems flattened, flowering later (early-middle summer); poor-soil grass.

Rough Bluegrass (Poa trivialis).—Very similar to Kentucky Bluegrass, but has rougher stems, and lacks underground rhizomes; used for moist, shady places.

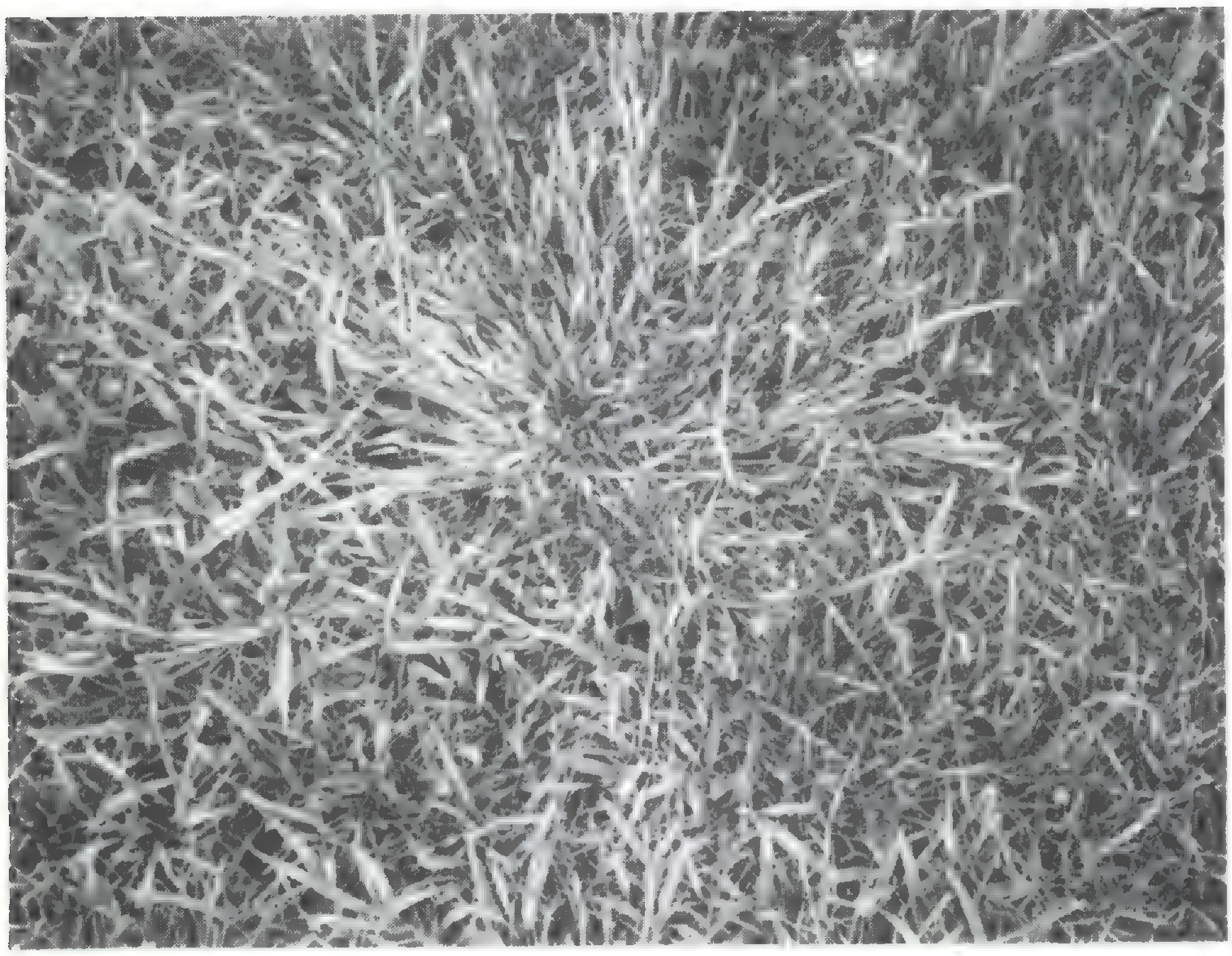
THE CRABGRASSES (DIGITARIA).—

Weedy, spreading, rooting from the joints and forming mats when permitted to lie flat; without underground stems (rhizomes); leaves pointed and flat, rolled in bud, a light or yellowish green, broader than those of bluegrass, with hairs at juncture of blade and sheath (near ligule); annuals, setting seed in late summer and autumn, dying with killing frost; seed not germinating until hot weather (May), so grass present only in summer and early autumn when it overruns lawns and smothers more desirable species; not tolerant of shade; flowers in one or more finger-like spikes, which frequently are too low to be mowed and thus are able to mature and perpetuate the species; perhaps chief competitor of bluegrass in the lawn community. Three species of Digitaria are frequent: *D. sanguinalis*, with leaves hairy; *D. ischaemum*, with the leaf sheath smooth; and *D. filiformis*, with the lower sheaths somewhat hairy and the spikes thin.

Crabgrass (*Digitaria ischaemum*). Photographed July 24, 1951.



Turf of Colonial Bent at the Garden. Photographed in early August, 1951.



Coarse mature redtop in bluegrass lawn, with some scattered crabgrass to left and below.

THE BENTGRASSES (AGROSTIS).—

Leaves flat, tapering and pointed at tip, rolled in bud, not thread-like as in fescues, small in the bentgrasses, large and coarse in mature redtop.

Redtop (Agrostis alba).—Frequent component of seed mixtures as quick-starting "nurse grass" for bluegrass, becoming coarse and unsightly after first year; usually forms persistent clumps with stems angling from the open center; creeping rhizomes short; leaves with long, conspicuous ligule at juncture of leaf blade and sheath; follows essentially the growth cycle of Kentucky Bluegrass but tends to be displaced by the latter on good soils.

Colonial Bent (Agrostis tenuis).—A slender, moderately fine-textured, spreading grass rooting from the lower joints, presumably requiring high fertility and occasional top-dressing but sometimes displacing bluegrass where the latter is mowed short; leaf with a short ligule at juncture of blade and sheath; has a more even growth cycle than Kentucky Bluegrass with summer flowering; known in a number of strains.

Creeping Bent (Agrostis palustris).—A lower, finer grass than Colonial Bent, of putting-green type and requiring much special care (frequent watering, top-dressing, careful and close mowing), seldom found in lawns; Velvet Bent *(A. canina)*, sometimes regarded as the finest of turf grasses, is similar.

Sheep Fescue *(Festuca ovina)* at right of light meter. Note windswept effect of foliage.

The Fescues (Festuca).—

Very narrow, tough leaves, the mature blades with margins usually more or less curled in, although leaf is folded in bud, even thinner than those of narrow-leaf strains of bluegrass; usually with a clumped, attractive, "wind-swept" appearance in lawns on account of dense clusters of thread-like foliage.

Sheep Fescue (Festuca ovina).—Found mostly in shade where competition with bluegrass is not too severe (as in dry or poor soil); not overly aggressive perennial, without either rhizomes or stolons, showing rather even growth from early spring through autumn.

Red and Chewing's Fescue (Festuca rubra).—Frequent component of seed mixtures, but on good soils generally giving away before the more aggressive bluegrass; resistant to drought and trampling, but often susceptible to disease; Chewing's variety forms bristle-like clumps, while typical creeping Red Fescue is said to spread from rhizomes, although not forming a closely-knit sod as does bluegrass; slow-growing, with cycle similar to bluegrass.

Other Lawn Grasses.—

Nimblewill (Muhlenbergia).—The only frequent lawn species of Muhlenbergia is *M. schreberi,* a semi-erect perennial with hard knot-like joints and comparatively short, flat, pointed leaves rolled in bud, the ligule hardly evident; reminiscent of Bermuda Grass; attractive but not desirable in lawns

because late in coming on in spring and has tendency to winter-kill; conspicuous in summer and autumn; shade-tolerant.

Bermuda Grass (Cynodon dactylon).—Similar when not in flower to nimblewill, tough, wiry, spreading rapidly by runners; leaves rolled in bud, the ligule a ring of hairs; a southern grass rarely winter-hardy in St. Louis and browning after killing frost; a selected strain (U-3) is winter-hardy in this climate, but must be planted from stem sections; same short-season (flourishing only in hot weather) disadvantage as crabgrass.

Goose or Yard Grass (Eleusine indica).—Tough, coarse, wiry annual from the tropics, difficult to cut with the mower; grows in semi-prostrate clumps suggestive of crabgrass, but the stems are flattened; no stolons or rhizomes; leaves folded in bud; frequent weed of waste ground; in hot weather from July to killing frost.

Foxtail (Setaria).—Broad, tapered, pointed leaves suggestive of redtop; mostly bunch grasses, distinctive for the cylindrical spikes in summer; leaves rolled in bud, the ligule a ring of hairs; several species, both annual and perennial; found especially on soils and in areas unfavorable to better grasses; summer weeds. Various species of the genus Hordeum (barley) are very similar.

Annual or Italian Rye (Lolium multiflorum) and Perennial Rye (L. perenne).—Much used as is redtop for quick cover or nurse grass, but become coarse after first year; leaves flat, pointed, rolled in bud, with parchment-like ligule, distinctive for auricles ("ears") at top of leaf sheath, yellow-green; quick spring germination gives beautiful cover until hot weather; flowering in distinctive narrow spikes in late spring and early summer; quick to disappear (especially annual rye). Domestic rye is a mixture of annual and perennial species.

Broadleaf Plants (Dicotyledonae)

Dandelion (Taraxacum officinale).—Perennial member of daisy family familiar to almost every one; considered objectionable in the lawn because of the coarse rosette of foliage from large drought-resistant taproot; bears unsightly seed stalks, especially in the spring.

Plantain or Buckhorn (Plantago).—Broadleaf *(P. major)* and narrowleaf *(P. lanceolata)* plantains are the most frequent species in St. Louis lawns; they form dense rosettes of coarse leaves in spring, and persist into winter, flowering with objectionable rough spikes throughout the summer.

Chickweed (Stellaria media).—Has a cycle much like Annual Bluegrass, being annual, active very early (February), setting seed in March, and dying before summer; seed germinates in autumn for preliminary growth before spring; trailing, rooting at joints, yellow-green; opposite ovate leaves and

Lawn weeds: extreme left, nimblewill; middle left, broadleaf plantain; lower left, crabgrass; upper right, narrow-leaf plantain; middle right, dandelion.

small white flowers; forms unsightly yellow patches in spring lawn, but difficult to control because of early growth.

Clover (Trifolium repens).—Familiar 3-foliolate creeping plant with white heads of flowers in late spring and summer; comes on more slowly than Kentucky Bluegrass but cycle otherwise much the same; usually not objectionable in lawn and may contribute to soil fertility (nitrification).

Knotweed (Polygonum aviculare).—Low, spreading, hot-weather annual reminiscent of chickweed in spring, but dark green, with alternate leaves and thin papery sheaths at the joints; too low to be effectively controlled by mowing, but cannot compete with vigorously growing sod on fertile soil.

Carpetweed (Mollugo verticellata).—Spreading annual forming flat circular patches, with several narrow leaves at each joint and small whitish flowers; chiefly a hot-weather species of rather bare soils.

Henbit (Lamium amplexicaule).—Low plant with rounded, scalloped leaves, square stems, and compact pinkish flowers among the leaves; especially active in spring.

Neckweed (Veronica peregrina).—A comparatively innocuous small annual with opposite leaves and inconspicuous flowers; spring plant, dead by midsummer.

Milfoil (Achillea millefolium).—Another member of the daisy family, with fine feathery "fern-like" foliage and desirable aromatic fragrance when crushed; seldom objectionable where mowing is practiced.

Black Medic (Medicago lupulina).—Trailing, clover-like plant with heads of yellow flowers in late spring and summer; difficult to eradicate but no more objectionable than is clover.

Of course, innumerable other species of both grasses and broadleaf weeds will be found locally in lawns, but typically the struggle for your lawn space will be fought out by these plants. How you prepare and handle that lawn will largely decide which members come to dominate the community—in short, whether you will have a bluegrass or "weed" lawn.

PREPARING THE SEEDBED

For the person who has the means, the time, and the patience, much can be done before ever the grass seed is sown to assure good sod of a desirable kind. Ideally, one should start many months ahead of the autumn seeding time by planting green manures and cover (rye, various legumes such as Korean Lespedeza) to be plowed under during the summer. In addition to the green manure, organic matter, deficient in most soils of this area, can be added in the form of weed-free compost, rotted manure, peat, or various commercial products. Such build-up of the soil can be accomplished only *before* sod has formed; thereafter only surface application of fertilizers will be possible. A seedbed well prepared beforehand will pay high dividends later in lessened maintenance and a better lawn. Unfortunately, not many of us are in a position to undertake such elaborate preliminary preparation. More likely, we are merely endeavoring to improve an already established lawn. Nevertheless, in the seeding of any new area some thought must be given to soil preparation.

The first step in establishing a new lawn should be grading. Neither steep slopes nor depressions where water accumulates can ever support good plant growth. If possible, a slope should extend away from the house, gentle enough to provide drainage without causing severe runoff and washing. Topsoil should not be covered by subsoil brought up from foundation digging. In this area most subsoil horizons are something of a hardpan clay, and are almost impossible to put into adequate physical condition for good root penetration.

Grading today is mostly done by bulldozers, and compaction of soil incurred by their use should be offset by a final light harrowing or disking. Rotary tillers may be used for this operation, but they may "fluff" surface layers to such an extent that months may elapse before final settling occurs. In time, local depressions and unevenness of surface might result. If weed

seeds are apt to be abundant, they should be allowed to germinate and the seedlings killed by repeated disking, or the soil surface may be sterilized with a suitable pre-seeding or pre-emergence herbicide.

The next step after disking is to incorporate necessary fertility elements into the soil. This can be done intelligently and economically only if one knows what kind of soil he has to start with. A soil analysis can be obtained through the county agent, or one can run simple colorimetric tests himself with kits now on the market. Even if no marked deficiency is indicated for available nitrogen, phosphorus, potassium (the major fertility elements—the N P K analysis on your fertilizer package), or for calcium, a light spreading of complete fertilizer may well be applied before seeding to provide a "boost" for autumn seedling growth. If deficiency shows for one or more elements, these may be corrected for by application of appropriate materials (ammonium nitrate or ammonium sulphate for N; superphosphate or rock phosphate for P; wood ashes or potassium salts for K). The acidity-alkalinity condition (pH) of the soil, easily determined with colorimetric pH kits, may suggest need for lime (calcium). If the pH is below 7—that is, on the acid side—lime would probably be helpful. A rate of one ton of agricultural limestone per acre will raise the pH from about 6 to 7 (neutral), or lesser rates of hydrated lime may be used if more convenient for the small place. Bluegrass, although tolerant of a wide pH range, has the reputation of preferring well-limed as well as fertile soils.

In the St. Louis area poor structure of the soil (suggested by great stickiness or gumminess and poor subsurface drainage in wet weather, by excessive hardening and caking in dry weather; lack of aggregation of particles; tendency to spread and wash easily and not to absorb rainfall; light color) is as likely to be encountered as is chemical deficiency. An universal remedy for poor structure is incorporation of organic matter into the soil. Of course, organic matter in the form of manures or compost contributes to the chemical fertility as well, releasing the needed mineral elements rather more slowly than do most chemical fertilizers. There is less chance of "burn" of young grass from overdose of fertilizer with organics than with chemical types and perhaps better balance of minor elements, but the total N P K content may not be as high. Also, organic matter builds a more favorable environment for the beneficial soil microorganisms.

SEEDING

The soil surface should be finely pulverized before seeding. Formerly, grass seed was broadcast by hand, sifting it first in one and then another direction, or on larger areas with a hand-cranked whirlwind type sower. Today there are on the market many multiple-purpose spreaders (useful for spread-

Grass seed-spreader

ing fertilizers or herbicides at regulated rates, as well as for seed mixtures), in which a simple set-screw assures a regulated rate and uniform spreading of the seed. Recommendations usually call for about 6 pounds per 1000 square feet, but the home-owner often seeds even heavier "for good measure." This results in heavy competition between grass seedlings with resultant lack of vigor in all. Such weak grass is apt to brown out quickly in hot summer weather or winter cold. The average lawn well-seeded at half this rate, although perhaps appearing "thin" the first autumn, will likely produce more resistant turf the following summer, and the cost of seed will be saved as well. With spreaders, the desired seeding rates are readily obtained; just fill the hopper with the seed mixture and set the spreader according to the manufacturer's directions. For example, a spreader opening of about 4 or 5 with a Scott's spreader will give a reasonably light spread for new seeding. Simply walk the spreader over a well-prepared seed-bed and the lawn is well on its way toward realization.

Grass seed will germinate and grow most satisfactorily if a ⅛ inch layer of weed-free topsoil is sifted over the newly seeded plot; the seed should not be sown deeper than about ¼ inch. Since most home-owners find this top-dressing inconvenient or impossible, the next best measure is the familiar light raking-in of the seed, care being taken not to move about quantities of soil which might disturb uniform distribution of the grass.

After seeding and raking-in, rolling of the plot to compact the soil about the seed is in order. A loose mulch of weed-free straw or similar light

material will protect the new seeding from wash and disturbance in rains and waterings to come. As a matter of fact, one of the most effective ways to seed bluegrass is to scatter over the seed-bed bluegrass straw that has been cut with mature inflorescences (late spring), since that provides seed source and mulch in one. On slopes a mulch-type protection is almost a necessity. A common practice is to pin down burlap over seeding in such locations, the seedlings appearing through the mesh. Seed does not need light to germinate, only moisture and air, and bluegrass seedlings will not be visible for many days after sowing. Within a few weeks any heavy mulch should be gently raked away, or if it is of a loose porous type it may be left to decay in place, contributing thereby to the fertility of the soil.

With grass seeds and seed mixtures quality of the seed is of first importance The product should be weed-free, with compact solid seeds (no loose hulls), fresh and able to germinate well. For Kentucky Bluegrass, seed can be expected better than 95 per cent pure, with well over 2 million seeds to the pound, having at least 85 per cent viability. Even though quality seed may cost more, planting weed seed in a lawn is not economical at any price. For fine lawns straight bluegrass or bluegrass with some fescue is best used. Some quality or special purpose (shade, dry soil, etc.) mixtures include various other species, but for the average lawn this is just temporary furbishing that increases the price of the product but has no lasting effect. Ultimately, according to our predication, we intend to establish our lawn community as most favorable to bluegrass. Under such circumstances expensive or imported seeds of other species will likely fall before domination by our vigorous "favorite son." A number of bluegrass mixtures include redtop and domestic rye in minor proportions. Both germinate quickly and give attractive cover, acting as nurse grass for the bluegrass. Use of such mixtures is questionable, however, since the nurse grasses actively compete in the first critical year with bluegrass seedlings that we wish to establish. Even though domestic rye and redtop will probably be eliminated in time, they are coarse and unsightly if persisting beyond the first year.

Attention has been focused in recent years on selecting strains of bluegrass for better sod. Formerly, seed was almost entirely from types of bluegrass most easily field-grown and harvested—not necessarily the low spreading strains that would produce a better lawn. The Missouri Botanical Garden strain, developed at the Arboretum, has recently appeared on the market, but is not greatly different from other quality types. Markedly different is the Merion B-27 strain. It appears slower and more difficult to germinate, but produces a low, mat-like turf that has something the appearance and "feel" of Bermuda grass. It is also a darker bluish-green than typical Kentucky Bluegrass, approaching Canada Bluegrass in color, and is said to be

Turf of Merion B-27 strain of bluegrass. Photographed in late June.

disease and drought resistant. Provided it is not invaded by other strains of bluegrass or weed grasses it should require less frequent mowing. Future usefulness of selected named strains remains to be seen. It is reasonable to expect that "native" or "wild" strains of bluegrass are best adapted to local conditions and will gradually invade any lawn in a few years' time, perhaps taking over from pedigree strains such as B-27.

Lawn establishment is, of course, not always by seeding. Sodding, especially in new subdivisions, is a common practice. If precautions are used (proper season, planted quickly, watered in) it is generally successful, since the sod includes its own topsoil and is apt to be of bluegrass strains which have proved able to survive in the area (it is uneconomical to bring in sod any great distance). Usually, the problem with sod is one of improvement and weed elimination. Clumps of "wild" bluegrass sod may be gathered from vacant lots and successfully transplanted to fill "holes" in the lawn. This is really a form of plugging or spot planting, as is often done in establishment of bentgrass lawns. Creeping Bent, Velvet Bent, Bermuda, Zoysia, St. Augustine Grass, Carpetgrass and Centipede Grass are all commonly established by planting sprigs (shredded sod) rather than seed, although this technique has no place in the bluegrass lawn of the northeastern United States.

FERTILIZATION

In addition to fertility build-up of soil prior to seeding, lawn maintenance involves the application of fertilizer at least once during the year. Although organics can be used, from seeding stage on commercial chemical fertilizers

are perhaps more convenient since they can be easily distributed by spreader. Manures are apt to need hand spreading, remain unsightly if in lumps, and unless thoroughly composted or processed have objectionable odor.

Timing of fertilizer application is important. If we think back to our lawn community life we see in the early spring our favorite, bluegrass, beginning vigorous growth that tapers off to semi-dormancy in late summer, but is resumed again in autumn. On the other hand, bluegrass's arch-enemy, crabgrass, only starts when bluegrass tapers off in the heat of summer and grows vigorously until killing frost. Obviously, fertilizer applied in late spring or early summer will just about get into soil solution in time to spur crabgrass on its rise, while by its very nature bluegrass remains semi-dormant anyway and cannot be aroused to vigorous growth no matter how much fertilizer is applied. Much better for bluegrass in competition with crabgrass is to fertilize in autumn, or failing that, in very early spring. Actually, I have found little difference in vigor of bluegrass growth by late spring, whether fertilized in the autumn or early spring preceding. A good general practice (with a mixed lawn community) might be to fertilize heavily in September to bring the bluegrass into winter in good vigor, and again lightly in March.

Bluegrass has a reputation as a rather heavy feeder, especially of phosphorus. Fertilizers used for bluegrass lawns should have as much or more phosphorus than potassium. Since nitrogen is readily leached from soils, it is apt to be in short supply where organic matter is not abundant. Heavy nitrogen fertilization, however, accentuates vegetative growth (hence leads to increased mowing) and lack of hardiness. A fertilizer analysis of about 10:5:5, 10:10:5 or 10:10:10 (N P K ratio or percentages as given on the package) might be considered appropriate for bluegrass lawns if previous soil tests have shown the major mineral elements to be essentially in balance in the soil. Chemical fertilizers should always be spread according to manufacturer's directions, most conveniently accomplished by use of a spreader. Excessive amounts of fertilizer or unusually concentrated types can easily "burn" and perhaps kill the very grasses one wishes to encourage. It is not true that "if a little is good, more is better."

HERBICIDES AND GROWTH REGULATORS

A wealth of possibilities confronts the lawn enthusiast in the relatively new field of plant growth regulators. We already have indications of substances (such as TCA or Maleic Hydrazide) in proper concentrations slowing growth (and making mowing unnecessary?). Certain 2-4-D compounds can free our lawns of dandelion, plantain and knotweed, and phenyl mercuric acetate can selectively rid the lawn of crabgrass[2]. Potassium cyanate is less

[2] See "Evaluation of a selective crabgrass killer." Mo. Bot. Gard. Bull. April, 1951.

Narrow-leaf plantain in fescue lawn, showing contortions and kill from 2-4-D application. Photographed June, 1951.

selective, but properly applied will kill certain kinds of crabgrass without permanent injury to turf. IPC (iso-propyl-N phenyl carbamate), often combined with 2-4-D ester, is reported to kill annual grasses, young chickweed, and certain other plants but to leave the majority of plants unaffected. Petroleum products (such as Stoddard Solvent), the "dinitros" (DNOSBP), and pentachlorophenol are selective under certain conditions, and the latter two have been used in pre-emergence treatment for annual weeds and for spring control of chickweed. Endoxohexahydrophthallate has controlled black medic, not affected by other herbicides. And, of course, a great many other largely non-selective plant killers are known, including ammate, arsenicals, borax, chlorates, cyanimid, salt, sulphuric acid, etc.

With this imposing array of jaw-breaking names and initials, and with many more likely to come, it is no wonder that confusion exists concerning herbicides. Moreover, the care needed to follow directions precisely has limited widespread use. But out of this jumble, perhaps initiating an age

of plant growth regulation, at least 2-4-D in its various formulations has been widely accepted and used in lawn maintenance. With use of 2-4-D, dandelions, plantains and some other broadleaf weeds can easily be eliminated from the lawn, and the labor of hand weeding, so common only a decade ago, is no longer a problem. Compounds of 2-4-D are sold in liquid form to be applied as a spray, or in a dry state for application with a spreader. At least one commercial concern combines fertilizer with 2-4-D, and markets the product as "Weed-and-Feed." Still, considerable caution must be taken with this, as with any herbicide, that desirable plants are not killed by wind drift, sprayer residues, or inadvertent treatment.

Phenyl mercuric acetate and potassium cyanate have found rather widespread use in crabgrass control, but, aside from 2-4-D, most other herbicides are still in the experimental stages. When techniques of their application finally crystalize, no doubt many additional products will appear on the market. Until more is known concerning them the home-owner will perhaps be wise to refrain from inordinate use of the newest herbicides. For one thing, little has yet been proven concerning their residual toxicity in soils, and whether there is significant or cumulative toxicity, especially for mammals.

WATERING

The subject of watering the lawn was more fully considered in a previous BULLETIN.[3]. In general, soils of our area are low in absorptive organic matter, tend to puddle, and become rather impervious to water penetration. Where the soil surface cannot be worked, as where insufficient organic matter was incorporated originally or was not applied later as top-dressing, deep water penetration becomes possible only with gradual and prolonged sprinkling. On slopes particularly, water runs off almost completely under a system of short violent sprinkling—a manifest waste of water and conducive to soil wash. Rainfall, of course, cannot be controlled, but if the hose is allowed to run for several hours in one place with a gentle spray the water will generally penetrate several inches. Canvas seepage hoses have in some places proven effective, but "root feeder" jet devices (tapered metal tube thrust into soil with perforation at bottom and hose connection at top) are of little utility on our soils of high clay fraction.

Watering is best done infrequently but thoroughly on established lawns. Chief effort should be directed towards getting deep water penetration uniformly over the area, even if this can be accomplished only once every two weeks during drought periods. Light daily sprinklings merely moisten the soil surface, and a good portion of the water evaporates. Light sprinkling is detrimental to deeper-rooted bluegrass that is normally approaching semi-

[3] Watering the home lawn. Mo. Bot. Gard. Bull. June, 1948.

dormancy during the dry summer periods; its roots tend to grow toward the temporarily moist surface, and are subject then to the next day's drying out that adapted crabgrass readily takes in stride. Hot weather and high soil temperatures will keep bluegrass relatively inactive in late summer, no matter the amount of sprinkling practiced. Such sprinkling is helpful to bluegrass only in so far as it prevents complete drying out of the soil and root kill, and temporarily reduces soil temperature a bit. Usually rainfall provides adequate moisture during autumn and spring, when bluegrass growth is active, and sprinkling is only necessary then on newly seeded areas.

Withholding water in the summer will catch the weed seedlings at their most susceptible stage, just after seed germination, and may effect rather heavy kill. By the same token lawns newly seeded to grass in autumn or spring should never be allowed to dry out entirely. One of the most critical times in the establishment of a new lawn is after seed has started to germinate. With only an incipient root system to draw upon, the young seedlings will quickly wilt if the upper soil layer dries. Gentle sprinkling is thus a necessity for newly seeded sites.

Although fungus diseases of turf grass ordinarily receive little attention in the home lawn, it is well to remember that moisture tends to increase their damage. Often, the only practical means to prevent a disease becoming epidemic is not to water. Thorough drying-out of bluegrass and fescue turf is recommended when leaf-spot or melting-out (*Helminthosporium* spp.) occurs (usually in cool, moist weather). Prevention of over-lush growth by avoiding high-nitrogen fertilization will also aid in its control. This disease, the only one at all common in the average lawn, is characterized by the grass leaves developing brown spots or patches which may eventually extend completely across the leaf, killing the portion above this scar. It debilitates, but ordinarily does not kill, the grass plant.

AERATION

Most plant roots and the beneficial soil microorganisms must have air in the pore spaces between soil particles to carry on life processes, just as must animals breathing air. A good-texture soil has adequate capillary pore space which permits ready penetration of water. Water entering the capillary spaces will "pull" air in behind it as it gradually sinks to the subsoil or is absorbed by roots. This air is vital to grass roots, and its absence due to water standing in depressions (water-logging) in the lawn is often responsible for yellowing, stunting, and eventual killing of the turf (one type of scald). Ultimately, the site will be invaded by the less desirable water-loving sedges. Fifty per cent pore space in the soil is recommended as the ideal to provide adequate water penetration and aeration. Since soils in this

area are mostly on the heavy (less porous) side, the need for incorporating organic matter in the seed-bed and for proper grading to provide drainage is apparent. Fortunately, though, grasses, by their own growth, in time tend to improve soil aeration as some of the fine roots die, leaving small pores and organic residues where they had penetrated.

Less a problem in home lawns than in lawns of parks and public places is compaction and worsening of soil structure under pathways or where heavy equipment operates. To counteract this effect various perforating devices are being used. These employ in some fashion numerous hollowed tines which are thrust into the earth to remove small cores of soil through the sod. The perforations that result permit ready penetration of rain and air. In certain instances a home-owner might conceivably find use for one of the old foot-operated perforaters (supplanted today by expensive machines) used on golf greens, to aerate small spots of compacted soil in the lawn. Nature provides earthworms which may in time accomplish much the same thing through their burrowing. Earthworms are probably desirable in the lawn, provided castings are not objectionable (as they would be on putting greens or perhaps occasionally on very finely kept properties).

MOWING

Methods of mowing have considerable influence on the lawn community. Short mowing is a general practice among home-owners, who have the mistaken idea that the closer the mowing the better the looks; while actually the uniformity of the cut is more of a factor in appearance than the height. Short mowing favors weeds (crabgrass, chickweed, knotweed, dandelion) at the expense of more erect bluegrass or quick-cover such as domestic rye. Bluegrass mowed at 2½ inches, rather than the customary inch or less, will not only be a more vigorous competitor against other members of the lawn community but will tend to shade out the lower plants and make crabgrass raise its seed stalks high enough to be cut by the mower. For a striking example of the influence of height of mowing one need look no farther than the St. Louis Country Club fairways. In the rough, bluegrass mowed at a few inches height thoroughly dominates, but on the fairway proper, mowed very short for play, Colonial Bent (and crabgrass or broadleaf weeds if not otherwise inhibited) tends to take over from bluegrass. In previous BULLETINS[4] I have spoken of elimination of crabgrass from the lawn by not mowing the bluegrass lawn in summer for a period of two years. Especially should bluegrass be left long in summer as it goes into its critical period of semi-dormancy at a time when competition with crabgrass is at a peak. Of course, if creeping bent grasses instead of bluegrass are to be favored, low

[4] The Lawn—to mow or not to mow. Mo. Bot. Gard. Bull. March, 1948; A second look at an unmowed lawn. June, 1950.

and frequent mowing then becomes a necessity.

There is no uniformity of opinion as to whether grass clippings should be collected or raked in mowing, or whether let lie. Logic would indicate that the fertility put into the soil and built into the grass leaf had best be left in the lawn through gradual decay of the clippings. On the other hand, during periods of lush growth, clippings may be so voluminous as to smother patches of grass and to appear unsightly after drying. The newer rotary type mowers (in contrast to the traditional reel-type or sickle-bar used with large areas) usually shred the clippings sufficiently that in a few days they settle beneath the growing grass as an invisible organic mulch. In any event, frequent mowing during periods of active grass growth will minimize the problem of unsightly clippings, no matter the style mower employed. Mowing is not so much a chore as it was a decade ago, since most suburban homes, even those with 50-foot lots, are now supplied with gasoline-powered or electric mowers; although gasoline mowers are noisy, they have the advantage of not needing to drag a cumbersome electric cord about the lawn.

WEED CONTROL

Any plant growing where unwanted is a weed. Thus for our contemplated lawn any grass or plant other than Kentucky Bluegrass might be considered a competitor and hence a weed, although fescue, clover, and perhaps a few other species might be encouraged as partners of bluegrass. The chief weeds are crabgrass, chickweed, plantain, dandelion, and probably others locally important. Weed control at present can be considered to take three approaches: biological, mechanical, and chemical. However, as a postulate of lawn maintenance nothing is so effective in controlling weeds as is a healthy, vigorous grass sod. Of first importance, always, is the keeping "happy" of the dominant species (bluegrass in our case).

Biological Control.—This is the approach we all take, knowingly or otherwise, in making the lawn community a place where our favorite thrives at the expense of others. It may partake of various techniques embraced by other approaches, such as control of crabgrass by letting bluegrass grow high or unmowed in late spring. The fact that bluegrass starts growing in early spring gives it the jump on crabgrass, a sun-loving species. If the bluegrass has become high and dense by May, when crabgrass is just starting, crabgrass seedlings will be smothered and eliminated in good part by vigorous, shading bluegrass. I would suggest mowing bluegrass during the period when flower or seed stalks are forming, for if these are allowed to mature they will become too wiry for convenient cutting. There will still remain ample time to get tall, heavy bluegrass growth before crabgrass puts in an appearance. The same technique, however, will not work against chickweed or annual

Heavy crabgrass infestation. Yellowing (lighter) portions in midground have been treated with Scutl (phenyl mercuric acetate). Photographed July 24, 1951.

bluegrass, since these start the spring growth cycle as early or even earlier than does Kentucky Bluegrass.

Mechanical Control.—At its simplest, mechanical control involves the now largely obsolete practice of hand weeding—pulling up or digging—and ultimate destruction of the weed. Mechanical control is perhaps most effective with annual plants such as crabgrass, goosegrass, chickweed, and knotweed, which, if not permitted to set seed one year, will be eliminated from the lawn (except for dormant seed still in the soil or that blowing in anew from weed patches). Actually, it is almost impossible to eliminate all seeding of annuals, but by various techniques the quantity of seed set can be materially reduced, with a progressive decline of the particular species population. This is especially effective when combined with good biological control. An example of mechanical-biological control of crabgrass has already been given: mowing bluegrass high enough so that the crabgrass, coming up for light and air, has its inflorescences clipped by the mower before setting seed. Similarly, spring-type "rakes" have been designed for the front of mowers, to lift the crabgrass so that the mower will cut it. Sam Plant, chairman of the greens committee of the St. Louis Country Club, feels that this is quite effective in eliminating crabgrass from the fairways. Reproduction of perennials, such as plantain and dandelion, is hindered by regular mowing, although not to the same extent as are annuals, since the parent plants, unless eliminated, persist into the next year.

Chemical Control.—Specific chemicals are gradually being developed which eliminate one or several kinds of weeds, without permanent injury to the desirable turf grasses. Many herbicides, such as potassium cyanate, temporarily set back the permanent grass, but they are even "rougher" on the weeds. Firmly established in lawn maintenance now is 2-4-D.[5]. Used in almost any chemical form according to manufacturer's directions, it can easily free the lawn of the once formidably pestiferous dandelion and plantain. In the ester form it has some effect on chickweed, especially when warm days (above 60° F.) occasionally occur in autumn or early spring; and persistently used it will affect clover and almost all other non-grasses in the lawn. Phenyl mercuric acetate (marketed in dry form as Scutl) was mentioned as selectively effective in control of crabgrass, but is quite expensive. Potassium cyanate has been widely used to control crabgrass, but generally it burns all sod back to ground line, the perennials, however, recovering. It, the chlorates, arsenicals, ammate, and similar products can be used to spot-treat the lawn in early spring against chickweed; that is, to put a small spoonful of the chemical on each weed plant. Certain phenolic compounds (pentacholorophenol: "dinitros") now give promise of eliminating chickweed without serious injury to turf grasses. In the years to come we can expect significant new advances in the chemical control of lawn weeds, and similar advances among insecticides. Already chlordane offers remarkable effectiveness in ridding the lawn of ants and ant hills, and is useful for control of June and Japanese beetle larvae (grass root feeders).

QUICK COVERS

A final item in an over-all review of lawn establishment and care might be mention of species that can be quickly grown to give an attractive temporary cover until the permanent lawn can be established. Legumes would offer a logical choice, since members of this family normally have nodule bacteria in the roots, effective in building up the nitrogen supply. Legumes generally make an excellent green manure, but unfortunately there are few that meet the requirements for lawn use: low, fine-textured foliage; quick, early-spring germination in this climate; ready availability; and low price of seed. Of five legume types tested this spring[6]: Birdsfoot Trefoil and Hairy Vetch grew very poorly or failed to stand mowing and grass competition; Korean Lespedeza was too late coming on and did not compete very well with the annual grasses; Ladino and White Dutch Clovers proved uncertain of establishment in comparison to annual grasses, and would likely persist in spots even though a permanent turf of bluegrass alone is desired.

[5] The fabulous 2-4-D. Mo. Bot. Gard. Bull. June, 1947.

[6] Seed furnished courtesy O. M. Scott & Sons Co.

Fescue (right), Annual Rye (center, darker), and Winter Rye (extreme left), quick covers; permanent bluegrass in foreground.

Perhaps more useful than the legumes for quick cover is the familiar and frequently employed annual or domestic rye (see cover). The seed is comparatively cheap and can be sown heavily to discourage weeds and to encourage upright growth. Rye grass is very attractive in spring and early summer (it tends to die out in late summer, especially with mowing), and if mowed will not seed or persist to become obnoxious in the permanent turf. Various annual cereals (wheat, true rye, barley, etc.) may be similarly employed, but are coarser and less attractive. Perennial grasses such as the fescues, although ultimately more attractive than annual rye, prove too slow in germinating and coming-on to compete with and smother weeds effectively. There will generally be weeds to contend with, for seldom is it practical to apply pre-seeding herbicides (soil sterilization) before planting the quick cover, or to allow the lawn to lie fallow and repeatedly disk beforehand.

A FINAL WORD

It has been manifestly impossible to give instructions as to just what to do and what not to do in establishment of a good lawn under varied circumstances. Rather I have hoped to give an understanding of community life at the lawn level, so that any one, observing his lawn through the year, will be able to make intelligent decisions concerning familiar practices, enabling him to favor the wanted species (presumed here to be Kentucky Bluegrass) a little more and the competitors a little less. A beautiful lawn is seldom made quickly; rather it develops through the years by fertilizing, mowing, weed control, and the like.

THE MISSOURI BOTANICAL GARDEN

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SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 50,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

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Missouri Botanical Garden Bulletin

Vol. XXXIX OCTOBER, 1951 No. 8

MULCHES

GUSTAV A. L. MEHLQUIST

Mulches in one form or another have been used for a great many years, but it is only within the last two decades that the importance and benefits from mulching have been demonstrated and advertised to the point that practically no garden enthusiast could fail to hear about them. Many gardeners have claimed that mulching makes gardening easy. This is true in the same sense that automobile traveling is easier than by horse. With a well-trained horse even a drunkard, whether he got where he wanted to go or not, usually stood a good chance of getting home safely, for the horse ordinarily could find his way home without help from his "master." The drawback was that one could not get very far without undue effort and consumption of time, but the automobile, in the hands of an alert and skillful driver, will take one places in a hurry, and distant ones too. The requirement that the operator must be skillful and alert applies as well to mulching, for with the multitude of materials available to the gardener today and the fanciful and often misleading advertising that accompanies them, the gardener must be alert as to their potentialities and skillful in their use. Since Dr. Schery, in the companion article, is discussing actual results with several specific substances I shall limit myself to the general types of materials that have been used and point out some of the pitfalls that might trap the gardener who "sleeps at the wheel."

For practical purposes mulching materials may be grouped in three categories, namely: inorganic, semi-organic, and organic. The term semi-organic is not technically correct but it is a very practical one for which I have found no good substitute.

The inorganic group contains such substances as sand, cinders, gravel, vermiculite, glass wool, and others not so readily available. These materials are very useful in preventing lifting or heaving of shallow-rooted perennials in heavy soils during the winter months due to alternate freezing and thawing, or as a protection of outdoor seed-beds containing large and slow-germinating seeds. Their main drawback is that their continual incorpora-

tion in most soils may be harmful unless accompanied by suitable organic matter. Commercial nurseries will undoubtedly continue to use them for specific purposes but they cannot be generally recommended. Certain papers such as tar paper and aluminum foil also fall in this category.

The semi-organic group includes a number of materials of organic origin such as coarse straw, sawdust, wood chips, excelsior, redwood fiber, etc. However, they are so slowly decomposed that they are better used as inorganics unless special treatments are used to hasten their breakdown. Some of these materials may contain substances that are actually harmful if they have not been "weathered" for some time. This is due to the fact that the micro-organisms which eventually cause the decomposition of these materials when they come into contact with the soil, are unable to get sufficient nitrogen for their own growth. Under these conditions, the micro-organisms "borrow" the nitrogen from the surrounding soil, and the plants for whose benefit the mulch was put on often actually starve for lack of the necessary nutrient. Unless readily available nitrogen can be supplied, and it takes large quantities at times, these materials should be applied on top of a smooth and uncultivated soil to prevent close contact with the underlying soil. If cultivation is necessary in order to get rid of weeds, it should be shallow so as to leave the soil surface as smooth as possible. Because of these limitations the materials in this group are best used among shrubs, large perennials, or in row plantings of vegetables where the spacing is such that most of the mulch can be removed in the fall before the soil is plowed or spaded up. Small quantities of the mulch that escape the rake or fork can be incorporated with safety.

The materials in the third category, the organic group, comprise such substances as composted leaves,* peats, manures, and others. Since these break down readily and contain appreciable quantities of plant nutrients, they can be used on almost any planting with safety and yet perform all the functions required of a good mulch. In contrast to the materials in the preceding category, they are most beneficial when they come in intimate contact with the underlying soil as the roots of the plants often come up to feed directly in the mulch. Such mulches need not be removed at the end of the season but can be incorporated year after year with accumulating beneficial effects. There are a number of substances such as ground corncobs, ground tobacco stems, hay, spent hops, and others that are intermediate in their effect and should be used accordingly. These materials may cause nitrogen starvation for the same reason that the semi-organics do, but ordinarily not to a greater extent than can be readily counteracted by reason-

* For a discussion of composts, see Mo. Bot. Gard. Bull., June, 1949.

able applications of ordinary garden fertilizers (2–4 lbs. per 100 sq. ft.). The fertilizer may be applied on top of the mulch and at the same time.

Some mulching materials, such as peat moss (properly called moss peat), oak tow, and leaves from oaks and beeches, produce a pronounced acid reaction in the soil. This is a highly desirable feature in growing such acid-loving plants as Azaleas, Rhododendrons, Andromedas and others, so mulching materials for these plants should be chosen with that in mind. Where only acid-forming materials are available for plants that do not require an acid soil or will not tolerate it, agricultural limestone applied at the rate of 5 lbs. per 100 sq. ft. on top of the mulch will neutralize the acidity.

Whenever the roots of the plants are seen to be coming up to the mulch or even going through it, cultivation should not be practiced as it may undo much of the benefit produced by the mulch. If the proper mulch material is used, hand-pulling the few weeds that do come through will not be a difficult job.

The depth of the mulch naturally depends on the nature of the materials used. If the material is coarse and the plants are far enough apart, a depth of from 3 to 6 inches will be required; with finer materials 1 to 3 inches will be more suitable. Relatively fine substances such as peats, well-rotted manure, and compost will produce very good results even when applied as thin as half an inch, except that little control of weeds will be effected. Materials of high water-holding capacity and potential nutrient value such as compost, peats, manure or ground corn-cobs should not be applied too thick near the base of the plants. The reason is that the high potential nutrient content of these materials is good for pathogenic organisms as well as beneficial ones, and if a prolonged rainy period occurs before the plants are well established too much organic matter at the very base of the plant may favor damping off or various crown rots.

In addition to these considerations the price and availability naturally will also affect the choice of material to be used. Thus while mulches make gardening easier, the fullest and most lasting benefits are likely to come only to those gardeners who by nature are alert and through practice skillful.

Please—The Garden is interested in obtaining seeds of trees, shrubs, and wayside plants of ornamental value from Korea. Most Korean plants acclimatize very well in our Midwest, and the Garden has been growing Korean Azaleas and Viburnums for some years. But many more kinds of hardy Korean plants wait to be introduced into this country, and the Garden would greatly appreciate the services of any American in Korea who could send to the Garden seeds of Korean plants.

April. From front to back: peat, vermiculite, hops, tow, leaves, control, tanbark, ground corn-cobs, sawdust, shredded leaves, alfalfa hay.

Late June. Alfalfa hay solidly mulched between tomatoes, corn, muskmelons, beans (pole bean arbor in background), watermelons, sunflower (at right).

August. Squash, tomatoes, and melons have completely obscured the mulch.

THREE VIEWS OF A MULCHED VEGETABLE GARDEN TAKEN FROM NEAR THE SAME SPOT

MULCHES FOR THE HOME GARDEN

ROBERT W. SCHERY

Mulching is the spreading over the soil surface, especially about shrubs and between row plantings, any of a wide variety of materials that retard moisture evaporation, keep down weeds, and ameliorate the effects of sudden changes and extremes of temperature. Inorganic substances, such as glass wool, vermiculite, or aluminum foil, may be used as a mulch, but more commonly organic materials are employed that ultimately tend to improve soil fertility. The latter category includes an ever-expanding list of substances, among which buckwheat hulls, cacao shells, coffee grounds, compost, corn-cobs, grass clippings, hay, spent hops, leaves, paper, peat, pecan shells, sawdust, straw, tobacco stems, tow, and wood chips have found favor in regions where readily and cheaply procurable. Not all of these are available in the St. Louis area, and most gardeners find it expedient to devise mulches from waste or by-product materials that are locally abundant.

A great many gardening magazines and books have recently carried discussions of certain mulch materials. *Plants and Gardens* (publication of the Brooklyn Botanic Garden), Winter 1950, assembled a valuable series of articles or summaries from varied original sources concerning the subject of mulches. Each contributor discussed his pet mulch or relatively few mulches, but there was no evaluation of the different mulches by the same individual under practically identical conditions. During the year past I have tried to make a side-by-side comparison of mulches at my home in Kirkwood, Mo., with the aid and cooperation of the Garden. Kirkwood was chosen in preference to the Garden since the mulch material could be handled more uniformly and readily at home (there were nearly 2000 ft. of even-aged, identically planted *multiflora* roses, for example, not having to be "kept-up" for public appearance), and attention could be directed to this one specific purpose by a home-owner not confronted with the many responsibilities of an institution open to the public.

There are a number of general considerations in mulching that perhaps merit discussion before attempting to evaluate the mulches tried in Kirkwood. Of prime and increasing importance in an epoch of high labor costs and labor scarcity is the economy of effort that mulching permits. Thickly applied, 4 inches thick if possible, mulches are an effective barrier against weed growth. Once applied in spring, at no greater trouble than would be a hand cultivation of the same area, a thick mulch will save perhaps a dozen weed hoeings during the growing season. To be sure, an occasional vigorous weed always gets through the mulch and must be hand-yanked, and the edge of the bed must be trimmed to preserve neatness of appearance; but the gardener

need not fear weeds completely out of hand, say, when returning from a lengthy vacation. In my case, with five acres to tend in the capacity of a week-end gardener, this labor-saving aspect of mulch use assumes overshadowing importance.

Even where the labor-saving weed control afforded by mulches is of no great consideration, as might be true on a small property, the benefit afforded growing plants by mulching often makes the practice desirable. Some of the potential benefits to be derived from thorough mulching are:

1. *Moisture Retention.*—The mulch acts as an effective blanket against water evaporation from the soil, holds moisture in the soil for plant use through the summer period without or with infrequent waterings. Under a thick mulch one will generally find the soil damp, even during drought. This has not been too much a problem in the St. Louis area during the last few summers since rainfall has been generally adequate and distributed. However, a mulch might afford the critical balance between loss or survival of a valuable shrub in summers such as were prevalent during the 1930's.

2. *Rain Absorption and Soil Protection.*—When drops from heavy rain or sprinkling hit bare, cultivated soil, the surface soil aggregates break down (termed puddling), inhibiting water penetration of the soil and aggravating soil wash or erosion. A mulch sponges up the rainfall and in most cases gently conducts the water to the un-puddled soil below, into which water penetrates well. Thus mulches not only hold water in the soil but tend to put more there.

3. *Ameliorated Temperature Extremes.*—One of the most disastrous effects on ornamental plants is produced by sudden and pronounced tempera-

Mulches on tomatoes: leaves (midground); sawdust and tanbark (foreground and right). Late June.

ture change, a frequent occurrence in St. Louis. A cool spell may become torrid within a day (or vice versa), catching plants physiologically unprepared for the change. In summer, plants may suddenly wilt or "brown" under these circumstances (not having had time to get sufficient "sun tan," so to speak); while winter-kill and heaving result under conditions of repeated freezing and thawing. Under a blanket of mulch active feeder roots are not immediately frozen as a nor'wester blows in, nor are they stimulated to active "springtime" growth by a few mild days in winter. A mulch tends to level out temperature extremes, and may actually be a necessity for survival of certain exotic plants brought into St. Louis from more equable climates. With a mulch, soil temperatures are somewhat lowered in the extreme heat of summer, somewhat elevated in the extreme cold of winter.

4. *Soil Improvement.*—Improved surface structure of the soil results from any mulch, since the soil is spared beating from the rain. Under organic mulches, there may be further pronounced physical improvement with incorporation of humus, and fertility may be increased as the minerals from organic molecules are released by decay for re-use in the plant world. Beneath high carbohydrate mulches, as fresh straw or sawdust, there may be a temporary nitrogen deficiency until decay gets well under way. This is due to a drain on the nitrogen supply by the very micro-organisms that are to effect decay. Ultimately, all nutrients return to the soil as the decay organisms themselves die and disintegrate, but it is well with most mulches, especially those of high carbohydrate proportions, to supply a nitrogen fertilizer at least the first year.

5. *Increased Biological Activity of Soil.*—The abundance of micro-organisms and of even larger organisms such as earthworms usually correlates with the abundance of organic matter in the soil. When organic mulches are used, or when extremes of drying out, "baking," etc. are ameliorated through mulching, soil organisms tend to thrive, with consequent improvement of soil and benefit to plantings.

6. *Surface Improvement.*—Well-chosen mulches provide a clean, pleasant-appearing surface and will likely be preferable to bare soil for walking over, for fruit (as melons) to rest and develop upon, etc. The mulch serves as a "tablecloth," where a bare soil surface is objectionable.

7. *Buffering Action.*—The organic material of mulches provides the soil with a stockpile of weak (relatively chemically inert) organic acids, salts, and esters. These can absorb the "shock" of sudden chemical change, as might be caused by addition of strong inorganic chemical compounds. There is less danger of fertilizer burn or of extreme pH alteration where a buffer of organic mulch is present. The weak acids from organic decompo-

sition are probably instrumental in slowly freeing mineral nutrients from the soil for plant use.

These are, to my mind, the major beneficial aspects of mulching. Of course some disadvantages accrue, but these are greatly outweighed by the advantages. Among the former might be listed: tendency of roots to come to the soil surface immediately beneath the mulch, making them susceptible to kill if the mulch is not continuously maintained; nitrogen competition during early decay of the mulch; interference with mowing, especially if the mulch scatters readily and contains large particles; fire hazard in certain types of mulches during dry weather; and objectionable odor under certain circumstances.

A precursor to the type of mulching discussed is the so-called dust mulching. This consists of pulverizing the surface layer (inch or so) of soil, on the theory that capillarity is thus broken and the blanket of dust will inhibit water evaporation. Dust mulching is still recommended by certain authors, for example, with tea roses, but has been proven of no benefit in Agricultural Experiment Station tests. Whether or not it saves moisture, it certainly is conducive to wind or water erosion, and is exceedingly laborious in the bargain. Yet a loose soil surface aids penetration of

Various mulches on cole plants (left), and alfalfa straw about tomatoes (right).

moisture from gentle rains or watering. For this reason, compact soils should be cultivated or loosened before applying most mulches. It is probably wise, too, to apply any necessary fertilizer to the loose soil before applying the mulch, in order to assure ready and more complete penetration of the fertilizer into the root zone.

A common failing in use of mulches is providing too thin an application. Usually an inch of mulch is insufficient to inhibit weeds greatly and will have but moderate effect in other ways. With most mulches at least three or 4 inches of permanent thickness of material are needed for full effect. With shrubs or trees this thick application offers no problem, but with herbaceous plants, such as tomatoes, melon vines, cole plants, or corn, the gardener will frst have to practice clean cultivation or (where weeds are not a great problem) add the mulch gradually until the seedlings are several inches tall. Mulching the vegetable garden should be delayed until after the seedlings are well established, to avoid smothering them. Vegetable seeds are as unable to grow through a mulch as are the weeds the mulch is meant to inhibit.

The mulches tested in the Kirkwood trials included any likely material that could be procured last spring. They embrace a number of materials which the home owner is apt to have access to around the neighborhood for the hauling or for a modest sum. Several were products of the home grounds (viz., grass clippings, hay). Tried on *multiflora* rose rows, in shrub beds, and in the vegetable garden were:* ground corn-cobs (delivered in bulk at about $12.00 a ton; also available sacked from dealers at about $2.00 per 100 pounds); unground (but weathered) corn-cobs; alfalfa hay (cut on the home grounds); bluegrass hay; crabgrass hay (lawn clippings); spent hops (courtesy Anheuser-Busch Brewing Assn.); shredded leaves; unshredded leaves; spent osmunda fiber (from orchid potting sheds); horticultural peat (retailing at less than $3.00 per 85-lb. sack); oak sawdust (from a stave mill in Franklin Co.); oat straw; tanbark (courtesy Hermann Oak Leather Co.); oak tow (hauled from stave mill); vermiculite (retailing in sacks at about $2.00 for 15 pounds); mowed weeds (mostly Smartweed and Lamb's Quarters); wood chips (such as used for horse bedding). Buckwheat hulls, recommended for mulch where used in certain northern and eastern states, were exorbitantly priced (for mulch) here, being procurable only as chicken scratch. These were not tried, as were not the expensive or difficultly procurable aluminum foil, coffee grounds, and cacao shells. Pecan shells might have been tried, since they are available in this area, but these have been used

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*With every mulch a light sprinkling of complete (10-5-5) fertilizer was mixed, and after a few weeks supplemental light fertilization with ammonium nitrate was given to offset competition for nitrogen between plants mulched and decay organisms.

chiefly to make ornamental walks and do not decay readily. Waste stems from local tobacco factories are reported a good mulch as used in Tower Grove Park, but were not tried in Kirkwood. Nor was manure employed, since this would more properly be considered fertilizer and is seldom available in sufficient quantity for mulching purposes.

In trying these different mulch materials, some of them through the winter and all through the summer, one conclusion quickly became evident. This was that differing kinds of mulches had relatively little differential effect upon most plants*, at least in this short period. While the difference between mulched and unmulched sets of plants might show, the difference between sets of plants mulched, for instance, with spent hops and with ground corn-cobs (or almost any other kinds compared) was hardly detectable. Since almost all mulches, then, provided roughly equivalent benefits, the rating of the various mulches would resolve chiefly into an evaluation of the physical and economic features of the mulch material. In the following table there is given an opinion as to how these tested mulches compare.

COMPARATIVE RATING OF MULCH MATERIALS DISCUSSED IN TEXT

	Corn-cobs, ground	Corn-cobs, ungr.	Hay, alfalfa	Hay, bluegrass	Hay, crabgrass	Hops, spent	Leaves, shredded	Leaves, unshredded	Osmunda roots	Peat, hort.	Sawdust	Straw, oat	Tanbark	Tow	Vermiculite	Weeds	Wood chips
Physical cleanliness	4	2	3	4	4	3	2	2	3	4	4	3	3	3	4	1	3
Tendency to scatter	3	4	4	3	3	3	2	3	3	2	3	3	3	4	0	4	3
Weed and disease free†	4	2	3	4	4	4	1	2	4	4	4	3	3	4	4	0	4
Desirable particle size	4	1	3	4	4	3	4	2	2	4	4	2	4	3	4	0	3
Friability, etc.	4	3	3	4	3	3	3	3	4	3	2	4	3	3	3	3	4
Soil improvement	3	1	4	3	3	4	4	3	2	4	2	2	2	2	2	2	1
Fire hazard	4	4	2	2	2	4	4	2	3	4	3	1	3	3	4	2	3
Cost (in money or effort)	3	3	4	4	4	3	3	4	3	3	4	3	3	4	2	4	3
Availability	4	2	4	4	4	2	2	4	1	4	3	3	2	3	4	4	3
Attractive surface	4	1	2	4	3	3	4	2	2	4	3	2	4	3	4	0	2
Attractive color	3	2	2	3	3	3	3	2	3	4	3	2	4	3	3	0	2
Weed control	3	1	4	4	3	3	1	2	2	1	3	1	2	2	0	1	2
Mowing interference	3	1	2	3	3	3	4	3	2	4	4	2	4	3	4	1	2
Ease in handling	4	2	3	4	4	2	4	2	2	4	3	2	4	3	4	1	3
Deleterious growth effect	4	4	4	4	4	4	4	4	4	4	2	4	4	3	4	4	4
Odor	4	4	4	4	4	1	4	3	4	4	3	4	3	3	4	4	4
Resiliency	4	4	4	4	3	3	3	3	4	1	2	4	3	3	2	3	3
Heat in decay	3	4	2	3	2	1	3	2	4	4	3	3	4	4	4	2	4
Total points (out of possible 72)	65	45	57	65	60	52	55	48	52	62	55	48	58	56	54	36	53

†With hay types, it is presupposed that cutting was done when material not in fruit.

*This generalization might not hold true for certain kinds of plants needing special growing conditions. For example, it is likely that the acid-loving members of the Azalea family would benefit far more from a mulch providing a low pH, such as spent hops, than one that would give a neutral or alkaline reaction.

Many of these characteristics will vary, depending upon when, how, and from whom the mulch was procured. This is especially true for presence of weed seed, cost, availability, and cleanliness. Furthermore, not all characteristics carry equal weight in choosing a mulch. For example, no matter how well vermiculite might rate in the majority of the characteristics, one important deficiency, its tendency to be lost by blowing, makes it unsuitable as an outdoor mulch; spent hops, with a total score below sawdust, wood chips and similar materials, would probably be preferable to them because its faster decay gives a spongy tilth to the surface and there is less nitrogen competition. Thus, total-point score as is derived from adding all item ratings for each mulch is not necessarily indicative of the over-all superiority of that mulch material. In the scoring 4 is the best score possible for the desirable feature of the characteristic mentioned and that figure may be thought of as indicating excellence, 3 as good, 2 as fair, 1 as poor, and 0 as failing more or less completely.

SPECIFIC COMMENT ON THE MULCHES LISTED IN THE TABLE

Ground Corn-cobs.—Round or angular particles ⅛ to 1 inch; a relatively new mulch utilizing a waste material in and about the Corn Belt, widely advertised and now finding increasing favor with commercial growers; rates high or acceptable on almost all counts, but is said to continuously jam reel-type lawn-mowers if once scattered through the lawn. One of the cleanest and most easily handled (shoveled or poured) of mulch materials, in time improving the soil.

Ground corn-cobs on *Buddleia* (back), Berberis (left), Pyracantha (center), Berberis (right). August.

Unground Corn-cobs.—Whole cobs, several inches long and ungainly until decayed; present obvious difficulties because of their size, but often are free for the hauling and will compost in a year or two. Apt to contain weed seed because of being casually dumped or stored.

Alfalfa Hay.—Coarse stems and leaf fragments from the alfalfa herb; any vegetative waste or hay cut from legumes would be similar (viz., clover, sweet clover, etc.); a valuable and nutritious feed material, apt to be used for mulch only where locally available in small quantities not worth commercial cutting and curing. Most easily handled when freshly cut (green, not dry); one of the best mulches for soil improvement and weed control, but rather coarse and ragged in appearance.

Bluegrass Hay.—Slender grass blades (Poa), up to a few inches long; available to many home owners as lawn clippings. Has excellent physical characteristics, light and resilient, but is not the high-nitrogen source that is alfalfa or other leguminous hay.

Crabgrass Hay.—Culms and blades of Digitaria, up to a few inches in length; the familiar summer lawn clippings for most of us. Coarser and not so resilient as bluegrass, but rates high on most counts.

Spent Hops.—Flat, thin, leaf-like bracts of the hop inflorescence, about ½ inch long; waste material of the breweries, available in the East, but so far in St. Louis not for public purchase (cost of handling, drying, storing, etc. thought to be more than product could bring on the gardening market). Soaking wet and dripping as taken from brew kettle, the hops ferment quickly and retain "brewery" odor for many weeks; hard to handle because of moisture and do not shovel well. In mid-winter with ice on ground I

Alfalfa straw about tomatoes and squash. Late June.

have found temperatures of nearly 100° F. in the center of decaying hops pile. This mulch is recommended highly at Arnold Arboretum, especially because of fire resistance; tends to be scattered in winter by birds seeking seeds (spent grain from mash?), but otherwise has commendable insulating characteristics; said to develop soil acidity; quick-decaying.

Shredded Leaves.—Fragments of leaves mostly less than 1 inch long; a very good all-around mulch material, but generally of limited availability because of infrequency of shredders in most homes. To rate highly this mulch should be made from clean, weed-free leaves (in the St. Louis area almost exclusively deciduous hardwoods).

Unshredded Leaves.—Whole leaves, up to several inches long; offer many of the same qualities as the preceding but tend to mat and compact more, are less attractive, and build up the soil more slowly; usually available for the raking in autumn. Mulching with leaves is often spoken of as sheet composting—i.e., decay *in situ* in the garden rather than on the compost pile.

Osmunda Roots.—Masses of tangled, slender roots of the Osmunda fern; residue from orchid repotting, scarcely available to the general public but suggestive of the type of coarse, wiry filling fiber that might be found in old, cheap mattresses or cushioning (such materials as coir from coconut shells, or Spanish Moss).

Horticultural Peat.—Black powder from processing peatbog muck; readily procurable from seed and supply stores in sacks, but rather expensive for mulching purposes. Horticultural peat is a fine, moisture-holding organic powder of excellent "feel" and appearance. Peat moss, sphagnum peat, or moss peat are names covering a coarsely granular material of Sphagnum Moss originally sold in this area usually under the name of Canadian peat and which is less decomposed and therefore usually coarser than horticultural peat. Peat moss exhibits high water-holding and aerating capacity and because of its acid reaction is ideal as a mulch for acid-loving plants; also good for non-acid plants unless the soil is already well on the acid side.

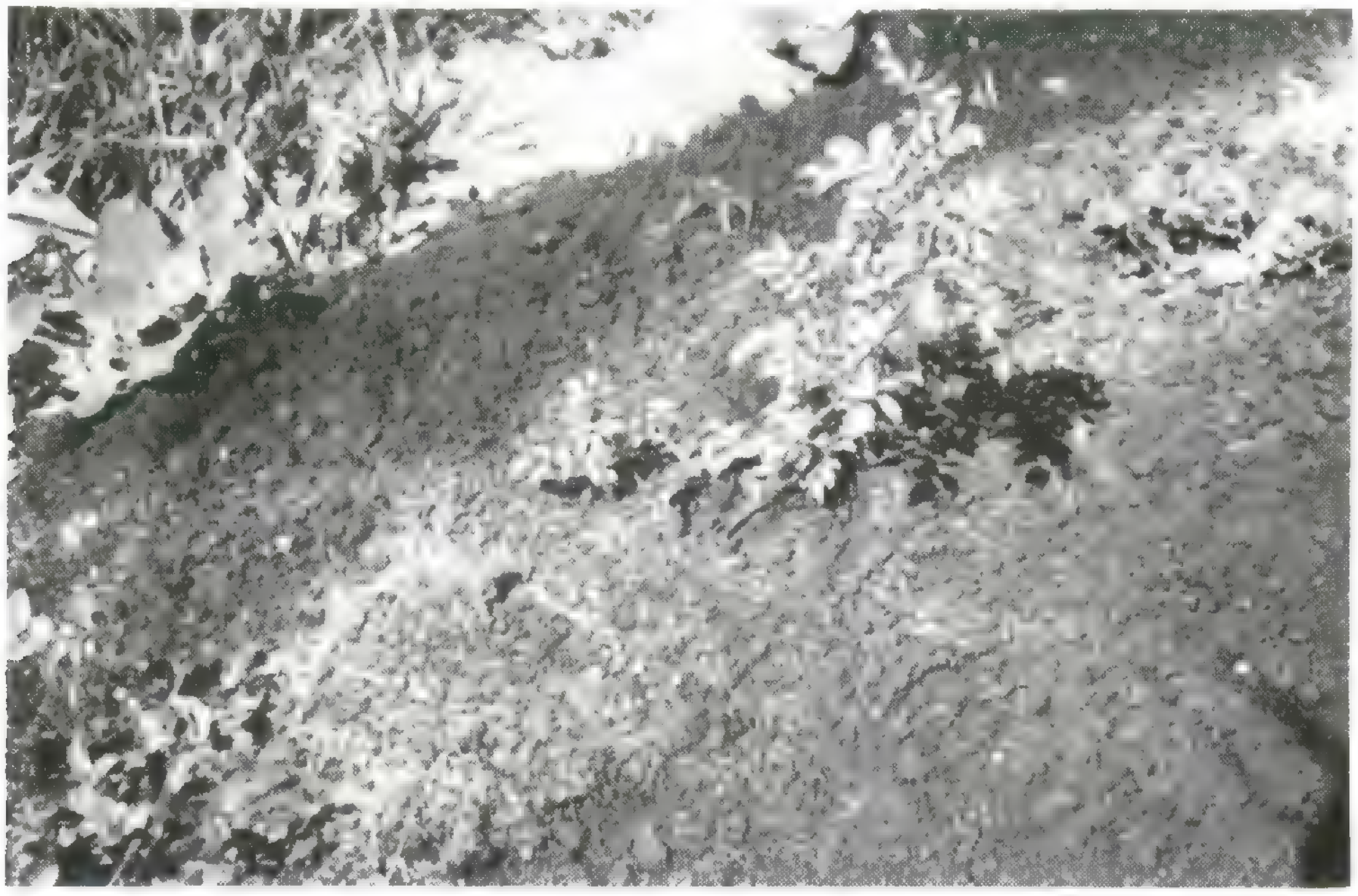
Oak Sawdust.—Minute wood fragments from sawing; hardwood sawdust is generally available from local sawmills or woodworking industries, often free for the hauling; White Oak sawdust is abundant at the many stave-sawing mills south and west of St. Louis. A moderately useful mulch, tending, however, to compact a little too much, exhaustive of nitrogen in decay, and apparently giving off growth-inhibiting gases when fresh.

Oat Straw.—Stems of the oat plant after threshing, several inches long; a loose, yellow, resilient mulch, but temporarily exhaustive of soil nitrogen and apt to contain seed. Fine for starting new grass but somewhat coarse and unkempt for shrub beds.

Vermiculite on *multiflora* roses

Tanbark.—Small bark fragments, coarser than sawdust, discarded by tanneries after soaking and leaching to extract the tannin; often procurable from tanneries. One of the best appearing and easiest handled of the mulch materials tested.

Oak Tow.—Similar to sawdust, but containing coarser wood strings up to an inch or so in length; made by tearing the wood lengthwise in sawing stave bolts. For most purposes superior to sawdust as it does not compact or blow so readily.



Horticultural peat on *multiflora* roses

Vermiculite.—An attractive, light, porous, mineral material ("puffed" mica) scarcely coarser than sawdust. Much employed in greenhouses but unsuitable for outdoor use because of easy scattering and loss.

Weeds.—Vegetative portions of unwanted plant growth. Weeds pulled or cut before setting seed can often be piled or let lie to serve as a mulch of sorts, but care is necessary to lay them with roots exposed to the air to prevent re-rooting.

Wood Chips.—Wood fragments up to an inch or so long, from planers or chippers; sometimes available from millwork factories and coming to be locally made in portable chippers from waste and cull trees on many farms. After being used as animal bedding wood chips have added fertility value; possess many of the same attributes as tow and sawdust.

NOTES

Dr. Henry N. Andrews, Paleobotanist to the Garden, has been awarded a Guggenheim Fellowship effective from July, 1951 to February, 1952. He will spend most of that time at the Botanical Museum of Harvard University, studying the fossils he has recently collected in Kansas and Illinois.

In connection with his Guggenheim Foundation fellowship, Dr. Edgar Anderson, Geneticist to the Garden, spent three weeks at the Escuela Agricola Pan-Americana, Tegucigalpa, Honduras, where he has an experimental plot devoted to growing tropical strains of some economic plants. Mr. George Freytag, graduate student in the Shaw School of Botany, is in charge of the plot.

The September number (Vol. XXXVIII, No. 3) of the ANNALS OF THE MISSOURI BOTANICAL GARDEN has recently been issued, with contents as follows: "A Revision of Stillingia in the New World," David J. Rogers; "The Recent Intrusion of Forests in the Ozarks," and "The Changing Forest Flora of the Ozarks," August P. Beilmann and Louis G. Brenner; "How Kentucky Bluegrass Grows," Alfred G. Etter.

Mr. George H. Pring, Superintendent of the Garden, presided at the annual meeting of the Kew Guild (alumni of the Royal Botanic Gardens, Kew), May 23, as its first American president. While in England he attended the Flower Show of the Royal Horticultural Society of Chelsea, acting as one of the judges of the orchid section. At the Kew Gardens he spent some time in the herbarium studying specimens of Nymphaea water-lilies for the possibility of discovering new African species suitable for breeding work in St. Louis. Research at the Kew Herbarium in 1948 resulted in the introduction of the two pygmy lilies described in the May 1951 BULLETIN.

New graduate students enrolled in the Henry Shaw School of Botany of Washington University are the following: Robert Cooper, of Auckland Institute and Museum, Auckland, New Zealand; Ding Hou, of University of Taiwan, Formosa; Richard N. Kinsley, of Earlham College, Richmond, Ind.; Jorge Leon, of Instituto Panamericana de Ciencias Agricolas, Turrialba, Costa Rica; Taylor Lindhorst and Frank Martin, of St. Louis College of Pharmacy: Bernard C. Mikula, of William and Mary College, Williamsburg, Va.; Norton Nickerson, of University of Texas, Austin; Dorothy Ober, of Cornell University, Ithaca, N. Y.; Roanne Roeyer, of Washington University; Emanuel Rudolph, of New York University, New York City.

Visitors to the Garden recently were: Dr. Joji Ashida, of Kyoto University, Japan; Dr. Robert W. Baxter, of University of Kansas, Lawrence; Dr. Lyman Benson, of Pomona College, Claremont, Calif.; Dr. Alexander F. Bucholtz, of Sick's Breweries, Seattle, Wash.; Dr. D. C. Fairburn, of McKee Jungle Gardens, Vero Beach, Fla.; Dr. Harry J. Fuller, of University of Illinois, Urbana; Dr. L. J. Gier, of William Jewell College, Liberty, Mo.; Dr. Charles B. Heiser, of University of Indiana, Bloomington; Dr. Henry Heusinger, of University of Wyoming, Laramie; Mrs. James Ingraham (Dr. Martha Beardsley), of Sharon, Pa., formerly graduate student in the Shaw School of Botany; Dr. David D. Keck, of the New York Botanical Garden; Dr. George A. Llano, of ADTIC Research Studies Institute, Maxwell, Ala.; Dr. Serge Mamay, of the United States Geological Survey, Washington, D. C.; Dr. Elizabeth McCracken, of Kansas State College, Manhattan; Mr. Thomas MacDougall, of New York City; Miss Eleanor McGilliard, of the University of Chattanooga, Tenn.; Dr. Balaji Mundkur, of Southern Illinois University, Carbondale; Dr. Gerald B. Ownbey and Mr. Frans G. Pieters, of University of Minnesota, Minneapolis; Dr. Reed Rollins, of Gray Herbarium of Harvard University, Cambridge, Mass.; Dr. Carl O. Sauer, of University of California, Berkeley; Dr. Jonathan D. Sauer, of University of Wisconsin, Madison; Dr. Lloyd H. Shinners, of Southern Methodist University, Dallas, Texas; Dr. Julian A. Steyermark, of Chicago Natural History Museum; Dr. R. A. Studhalter, of Texas Technological College, Lubbock; Dr. Alois Tavcar, of University of Zagreb, Yugoslavia; Dr. George Ware, of University of Oklahoma, Norman; Mr. Ernest T. Watanabe, rose grower, Honolulu, Hawaii; Dr. Paul Weatherwax, of University of Indiana, Bloomington; Dr. Johanna Went, of Phytopathologisch Laboratorium, Willie Commelin Scholten, Baarn, Holland.

NOTE: Dr. Mehlquist would appreciate it if any one having copies of the May, 1946 and September, 1948 BULLETINS, which contain his articles on orchids, would send them to him at the Garden, as his supply is exhausted.

THE MISSOURI BOTANICAL GARDEN

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SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 50,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah bus line (No. 42). The Southampton buses (No. 80), direct from downtown, pass within three blocks of the main entrance.

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Cover: Ruins of Chanchan in north Peru, prehistoric city of the Chimus, who made many of the crop plant models illustrated on pages 190–191. Chanchan was one of the great cities of ancient America; its ruins cover more than 10 square miles. The adobe walls shown are about five times the height of a man and surrounded one of the many walled compounds. Each great compound supposedly housed a clan and contained, besides streets and houses, its own gardens, reservoir, temple pyramids, and cemeteries.

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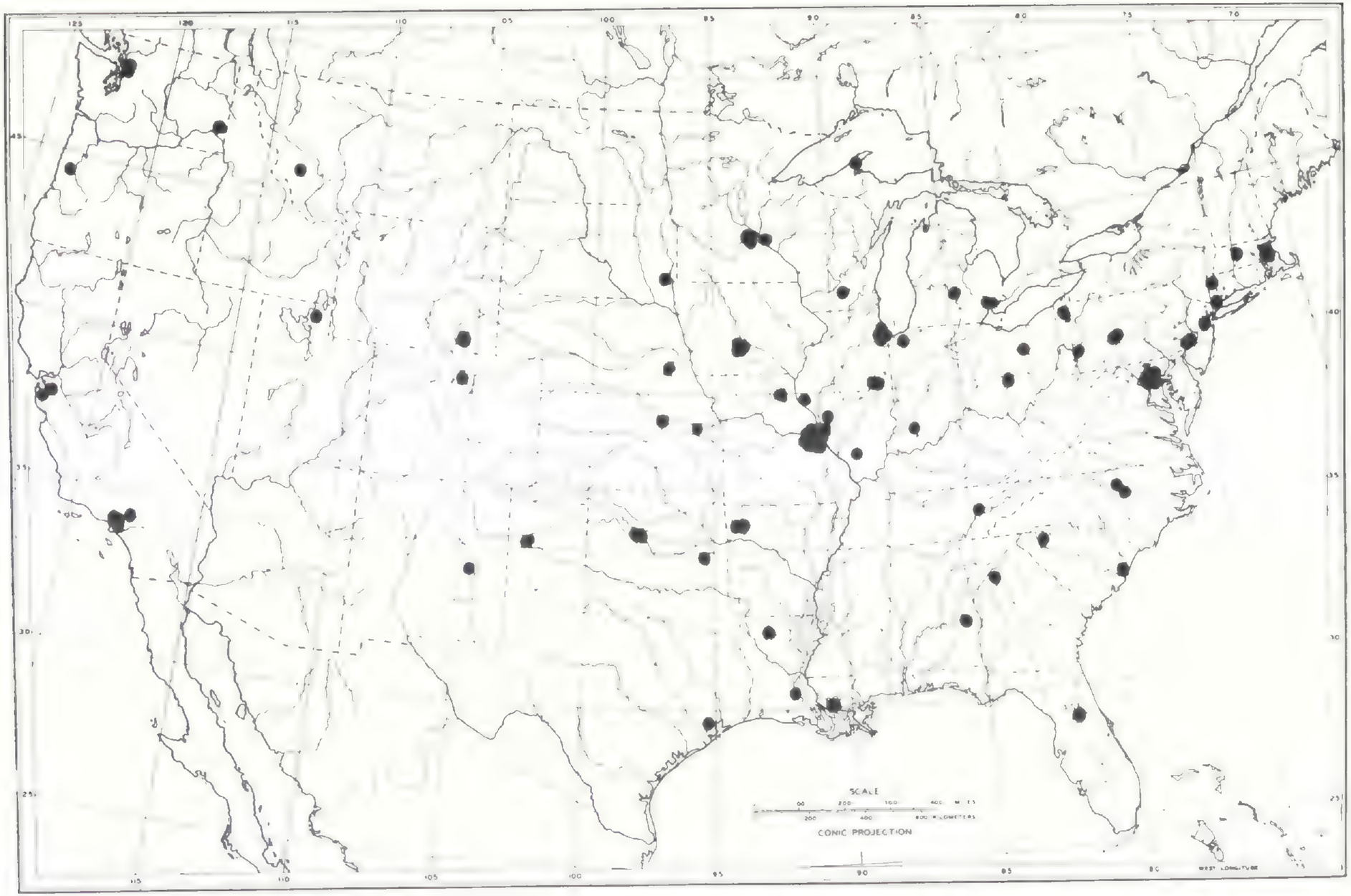

Map of the United States showing distribution of major positions held by graduates of the Henry Shaw School of Botany

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Missouri Botanical Garden Bulletin

Vol. XXXIX NOVEMBER, 1951 No. 9

THE HENRY SHAW SCHOOL OF BOTANY

GEORGE T. MOORE

Sometime in 1883 Mr. Shaw proposed to the Chancellor of Washington University that, with the concurrence of the Directors, he would like to endow a department of Washington University devoted to the study of Botany. After consulting with Professor Asa Gray of Harvard, and others, as to the best method to pursue, a special meeting of the Board of Directors was held on June 8, 1885, and the following resolution was unanimously adopted in grateful acceptance of Mr. Shaw's proposal.

1. That a School of Botany be established as a special department of Washington University to be known as the Henry Shaw School of Botany.

2. That a Professorship of Botany be therein established, to be known as the Engelmann Professorship.

3. That Professor Wm. Trelease, of Wisconsin University, be invited to fill the same; his duties to begin at the commencement of the next academic year, September 17th.

4. That said School of Botany be placed under the special care and direction of an Advisory Committee, to consist of five members of whom *two* shall be members of this Board and *two* shall be selected outside of the Board,—the Chancellor of the University being a member *ex officio*.

Later, improved property was conveyed to the University, yielding at the time $5,400 per annum. Mr. Shaw further provided in his will that "whenever the income net, of the property hereby bequeathed to the said University shall fall short of three thousand five hundred dollars ($3,500.) per annum I require that the Trustees of the Garden shall pay over to said University, such sum of money as may be required to make the annual income equivalent to three thousand five hundred dollars per annum." In accordance with this provision of the will, the Trustees of the Garden at times when the property was yielding little or nothing have paid to the University for the support of the School of Botany over one hundred thousand dollars.

Mr. Shaw in his will further empowered the Trustees of the Garden "to allot, if they think it expedient, from time to time, any of the income *not needed for the development and maintenance of the said Garden*, to the augmentation to the means and appliances of instruction."

Under the direction of Professor Trelease, with one assistant, the School of Botany supplemented the undergraduate department of the University by giving such instruction in botany "as could be arranged for." Special classes for persons wishing to do work in botany, but not connected with the undergraduate department of the University, were arranged. One course, for the study of grasses, was immediately offered, and later a class of young physicians was formed for the study of bacteria in connection with medical practice.

Until 1893, an assistant, appointed by Professor Trelease, was the only additional member of the staff. That year the former assistant was made an Instructor in Washington University, and the appointment made by the Board of Directors of the University. His duties and salary, paid out of the endowment fund, remained the same.

On the opening of the college year 1894-5 an additional instructor in cryptogamic botany was appointed, and fourteen botany courses were offered in the undergraduate department of the University. A course of Saturday lectures was given by Prof. Trelease at the Garden and another for children was given by an assistant at the Garden. One candidate for the Ph.D. degree was registered and the next year there was one candidate for the Master's degree.

In 1897 a second candidate for the Ph.D. degree was registered, followed by another candidate in 1898. At the commencement in 1899 the degree of Ph.D. was conferred on two students, and in 1901 on one.

In 1903 the Instructor in Botany was promoted to a newly established Assistant-professorship, and in connection with the new department of zoology the courses Botany 1 and Zoology 1 were replaced by a joint course, Biology 1.

No additions to the staff were made until 1909, when a professorship of plant physiology and applied botany was created, the salary paid entirely by the Garden. The Garden also provided two research fellowships for graduate students in botany. The next year three additional research fellowships were offered by the Garden and the graduate work in the School of Botany, which had always been encouraged, became more firmly established than ever.

The years 1911 and 1912 saw notable additions to the teaching staff in the appointment of a Curator of the Herbarium and Professor of Botany, a Mycologist, and a Professor of Physiology in charge of the Graduate Laboratory at the Garden, all paid by the Garden Trustees.

Subsequent additions to the teaching staff have been made from time to time, the incumbent devoting part of his time to the Garden so that a proportion of his salary was paid by the Garden. Not until 1947 did the University establish a real school rather than a department of botany. At that time a Dean of the Henry Shaw School of Botany was appointed and two new professorships were created, paid entirely by the University, with no help from the Garden.

The value of a school of this kind is best evidenced by its graduates. With the accent on research in botany and the conferring of higher degrees, the Henry Shaw School of Botany has long been recognized as an outstanding source of students qualified to fill top positions in colleges and universities throughout the country. The high standard set by the early graduates has been maintained continuously and while it is impossible to present a complete record, the list of positions held by former students in the Shaw School of Botany is indicative of the standing of the School and the character of instruction maintained throughout its history.

HENRY SHAW SCHOOL OF BOTANY ALUMNI

POSITIONS	LOCATION
UNITED STATES	
ALABAMA	
Assistant Professor of Horticulture	Alabama Polytechnic Institute, Auburn
ARKANSAS	
Associate Professor of Botany	University of Arkansas, Fayetteville
Professor of Plant Pathology	University of Arkansas, Fayetteville
CALIFORNIA	
Dean, College of Letters and Science	University of California, Berkeley
Professor of Botany	University of California, Los Angeles
Instructor in Biological Sciences	Leland Stanford University, Stanford
Associate Professor of Plant Pathology	California Citrus Experiment Station, Riverside
Geneticist	Rancho Santa Ana Botanic Garden, Claremont
Herbarium Botanist	University of California, Los Angeles
Director, Los Angeles Arboretum	Arcadia
COLORADO	
Micropaleontologist	Boulder, Colorado
DISTRICT OF COLUMBIA	
Office of International Trade Operations	Dept. of Commerce, Washington
Curator of Paleozoic Paleobotany	United States Geological Survey, U. S. National Museum, Washington
Associate Curator, Division of Cryptogams	United States National Herbarium, Washington
Chief of Publications	U. S. Dept. of Agriculture, Office of Information, Washington, D. C.
Principal Cotton Technologist	U. S. Dept. of Agriculture, Washington, D. C.
FLORIDA	
In Charge, Citrus Experiment Station	Lake Alfred
GEORGIA	
Mycologist, Veterans' Administration Bureau	Lawson Hospital, Chamblee

	ILLINOIS
Curator, Economic Botany	Chicago Natural History Museum
Research Coordinator for Medical and Biological Sciences	Office of Naval Research, Midwest Territory, Chicago
Professor of Botany	University of Illinois, Urbana
Professor of Biology	Principia College, Elsah
Instructor	Southern Illinois University, Carbondale
Research Department	Baxter Laboratory, Chicago
Curator of Herbarium	Chicago Natural History Museum
Professor of Plant Pathology and Head Division Plant Pathology in Horticulture	Illinois Agricultural Experiment Station, Urbana
Instructor in Biology	Quincy College, Quincy
	INDIANA
Assistant Professor of Botany	University of Indiana, Bloomington
Writing and researching on Agricultural History	Crown Point
	IOWA
Geneticist, Plant Breeding Department	Pioneer Hi-Bred Corn Co., Johnston
Assistant Geneticist, Plant Breeding Department	Pioneer Hi-Bred Corn Co., Johnston
In Plant Breeding Department	Pioneer Hi-Bred Corn Co., Johnston
Research Professor of Botany†	Iowa State College, Ames
Professor of Botany	Iowa State College, Ames
	KANSAS
Assistant Professor of Botany	University of Kansas, Lawrence
Professor of Bacteriology	Kansas State College, Manhattan
	LOUISIANA
Consulting Plant Technologist	New Orleans, La.
Professor of Botany	Louisiana Polytechnic Institute, Ruston
Senior Pathologist, Division Fiber Crops and Diseases	Louisiana Agricultural Experiment Station, Baton Rouge
	MARYLAND
Senior Pathologist, Fruits and Vegetable Crops	U. S. Dept. of Agriculture, Beltsville
Assistant Scientific Director and Chief	Toxicol. Branch Medical Division, Army Chemical Center, Md.
	MASSACHUSETTS
Associate Professor and Chairman Department of Botany	Mt. Holyoke College, South Hadley
Associate Professor of Botany and Curator of Herbarium	Wellesley College, Wellesley
Curator of Herbarium	Arnold Arboretum of Harvard University, Jamaica Plain, Boston
Assistant Curator of Herbarium	Arnold Arboretum of Harvard University, Jamaica Plain, Boston
	MICHIGAN
Head, Department of Forestry	Michigan College of Mining and Technology, Houghton
Botanist in Charge	Cranbrook Institute of Science, Bloomfield Hills
Geneticist	Detroit Institute of Cancer Research, Detroit
Professor of Botany	Michigan Agricultural College, East Lansing
	MINNESOTA
Associate Professor	University of Minnesota, Minneapolis
Dean, School of Agriculture, Forestry, and Home Economics	University of Minnesota, St. Paul
Professor of Botany†	University of Minnesota, Minneapolis

†Deceased

	MONTANA
Professor of Botany and Chairman Division Biological Sciences	University of Montana, Missoula
	MISSOURI
Professor of Botany and Dean	Henry Shaw School of Botany of Washington University, St. Louis
Professor of Botany	Henry Shaw School of Botany of Washington University, St. Louis
Professor of Botany and Curator of Herbarium	Henry Shaw School of Botany of Washington University, St. Louis
On Garden staff	Missouri Botanical Garden, St. Louis
Scientific Assistant	Missouri Botanical Garden, St. Louis
Assistant Manager	Missouri Botanical Garden Arboretum, Gray Summit
Research Department	Anheuser-Busch Brewing Assn., St. Louis
Head Department of Microbiology*	Anheuser-Busch Brewing Assn., St. Louis
Professor of Botany	Harris Teachers' College, St. Louis
Assistant Professor of Botany	Harris Teachers' College, St. Louis
Assistant Professor of Botany and Pharmacognosy	St. Louis College of Pharmacy
Medical Mycologist	Barnard Skin and Cancer Hospital, St. Louis
Botanist, Organic Development Division	Monsanto Chemical Co., St. Louis
Garden Editor and Writer, also Landscape Architect	St. Louis Globe-Democrat St. Louis
Chemist	Cole Chemical Co., St. Louis
Teacher of Science	Mary Institute, St. Louis Co.
Chairman Department of Bacteriology and Public Health	Kirksville College of Osteopathy, Kirksville, Mo.
	NEBRASKA
Chairman, Department of Plant Pathology	Nebraska Agricultural Experiment Station, Lincoln
	NEW JERSEY
Assistant Professor in Ornamental Horticulture	New Jersey Agricultural College, New Brunswick
	NEW MEXICO
Ford Foundation Fellow	New Mexico Military Institute, Roswell
	NEW YORK
Professor of Botany	Vassar College, Poughkeepsie
Member Rockefeller Institute	New York City
	NORTH CAROLINA
Professor of Plant Pathology	North Carolina State College, Raleigh
Professor of Botany	University of North Carolina, Chapel Hill
	OHIO
Chief, Department of Botany and Pathology	Ohio Agricultural Experiment Station, Wooster
Professor of Floriculture	Ohio State University, Columbus
	OKLAHOMA
Professor of Plant Sciences and Curator of Herbarium	University of Oklahoma, Norman
Chairman Department of Plant Sciences	University of Oklahoma, Norman

*Retired

OREGON	
Professor of Plant Pathological Research and Plant Pathology†	Oregon Agricultural College, Corvallis
Professor of Plant Pathological Research and Plant Pathology	Oregon Agricultural College, Corvallis
PENNSYLVANIA	
Professor of Botany†	Pennsylvania State College, State College
Assistant Professor of Botany	Allegheny College, Meadville
Professor of Botany and Director of Morris Arboretum	University of Pennsylvania, Philadelphia
Associate Professor of Botany	University of Pennsylvania, Philadelphia
Biologist and Leader, Pennsylvania Cooperative Wildlife Unit, U. S. Fish and Wildlife Service, Department of Interior	Pennsylvania State College, State College
Associate Professor of Biology	University of Pittsburgh
SOUTH CAROLINA	
Assistant Professor of Biology	School of Pharmacy, Medical College State of South Carolina, Charleston
Professor of Botany and Head Division of Botany and Bacteriology	Clemson Agricultural College, Clemson
Dean and Director	Clemson Agricultural College, Clemson
SOUTH DAKOTA	
Chairman Department of Bacteriology	South Dakota State College, Brookings
TENNESSEE	
Professor of Botany†	University of Tennessee, Knoxville
TEXAS	
Director of Research	Anderson-Clayton Cotton Co., Houston
Professor and Head of Department of Botany	Texas Technological College, Lubbock
Head Department of Biology	Sam Houston State Teachers' College, Huntsville
UTAH	
Professor of Botany and Plant Physiologist	Utah State Agricultural College, Logan
WASHINGTON	
Professor of Botany and Head of Department	University of Washington, Seattle
Professor of Botany and Curator of the Herbarium	State College of Washington, Pullman
Technologist	Sick Brewing Co., Seattle
WISCONSIN	
Assistant Professor of Botany	University of Wisconsin, Madison
Professor of Botany	Wisconsin State Teachers' College, River Falls
WYOMING	
Assistant Professor of Botany†	University of Wyoming, Laramie
EUROPE	
Lecturer in Botany and on staff of Botanic Garden	University of Turku, Turku, Finland
ASIA	
Lecturer in Botany	University of Rangoon, Burma
Professor	University of Formosa
Teacher of Botany and Associated Sciences	Lal Bagh Girls' School, Lucknow, India

†Deceased

SOUTH AMERICA

Assistant in Phytopathology	Inst. de Ciencias Naturales de Univ. Nacional de Bogota, Colombia

CENTRAL AMERICA

Botanist	Escuela Agricola Pan-Americana Tegucigalpa, Honduras
In charge of Economic Plots	Escuela Agricola Pan-Americana Tegucigalpa, Honduras

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CROP PLANTS OF ANCIENT PERU MODELLED IN POTTERY

JONATHAN D. SAUER

A nearly rainless desert, much of it barren and lifeless as the moon, stretches for more than a thousand miles along the coast of Peru. From the ocean to the mountains, wide expanses of the earth lie utterly naked, with no pretty mantle of vegetation to hide the raw mineral colors, soften the rough rock structure, and hold the blowing sand.

This wasteland must have seemed a terrible place to the prehistoric tribes who first wandered into it. Yet primitive peoples penetrated and settled this desert in extremely ancient times. They built their villages in a score of oases scattered along the coast, places where streams from the distant Andes crossed the desert to the sea. When they first arrived is not known, but remains have been unearthed on this coast of an agricultural civilization believed to be some 4000 years old, perhaps the earliest known agriculture in the New World.

Once these people had learned special skills needed for subsistence in this desert, life in their oases must have been pleasant and easy. Fish were plentiful in the coastal waters. The soil was good, especially when fertilized with bird guano from the coastal islands. The rivers brought a dependable supply of irrigation water. Each major oasis must have been almost a little world apart, separated from other oases by the wide deserts. Upstream they were cut off from the heavily populated highlands by the inhospitable sparsely settled lower mountain slopes, a zone of rough dry gorges, too steep for farming and infested by disease-bearing insects. Shielded from marauders but with some trade contacts with the outer world, each group of oases developed its own character and its own distinctive culture. Some of the villages grew to cities, and for many centuries these desert oases were among the greatest and brightest cultural centers in America.

The archaeologists have worked out the story in fair detail for the last thousand years or so before the Spanish conquest. The major coastal centers seem to have been largely independent during most of this time, but there were interludes when a fairly uniform culture spread over the entire coast, presumably by conquest from the highlands. The last of these began when the upstart Inca empire engulfed the coastal oases shortly before the Spanish conquest.

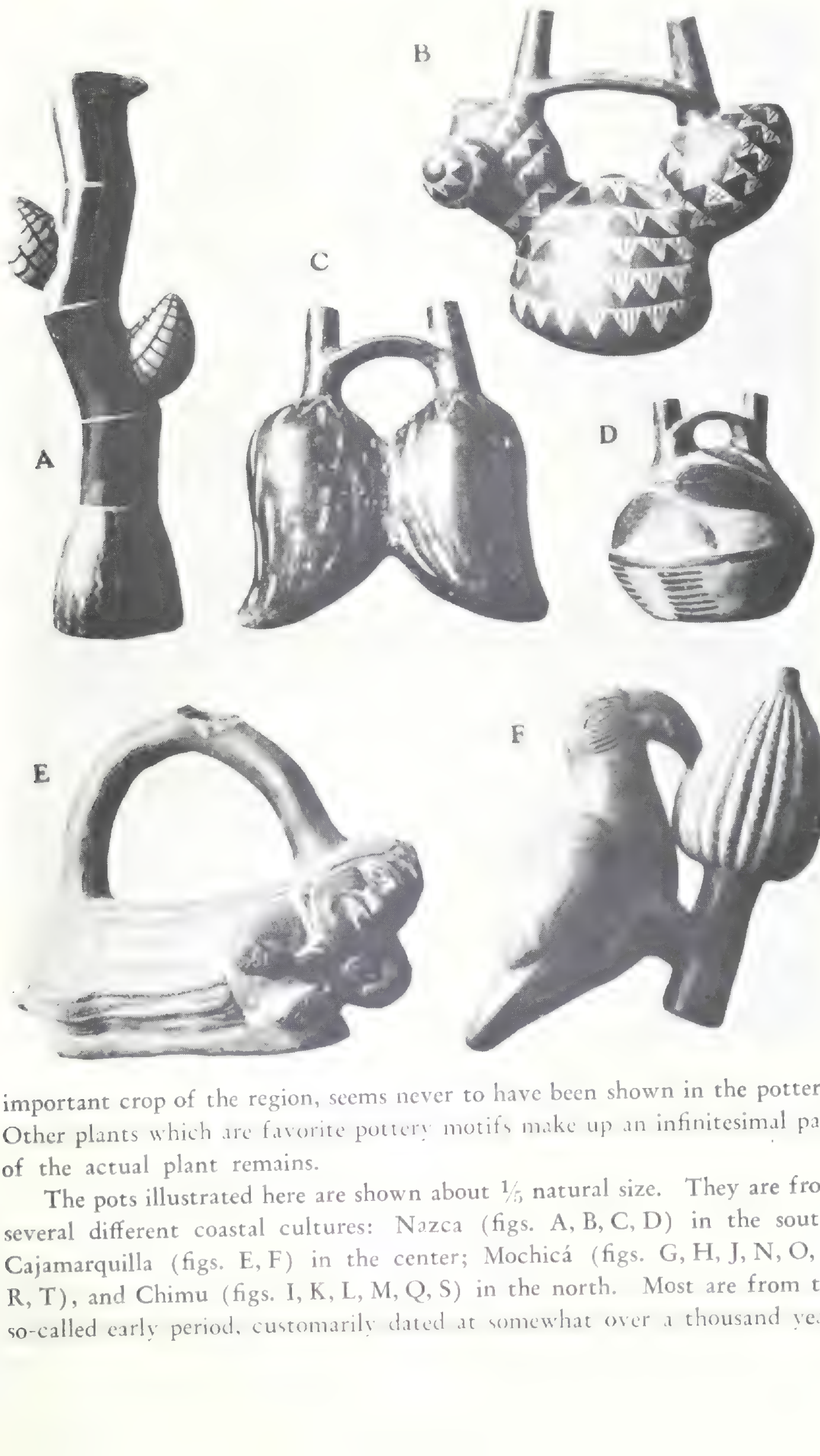
ARCHAEOLOGIC RECORD

The archaeologic record left by these ancient peoples is staggering in its richness. A person walking through one of their oases sees, among the modern settlements, countless traces of the distant past. Here and there the *huaqueros*, robbers of prehistoric graves, have destroyed ancient buildings and artefacts in their digging for salable curios, but mostly the old things have gone to ruin or decay very slowly. Some fields are still watered by aqueducts built a thousand years ago. In the incredibly dry ground even perishable things are preserved indefinitely. The famous Paracas blankets come out of their millenium of burial with fabrics and colors almost as strong as new. Seeds from gourds and squashes harvested some 4,000 years ago are dug up in good enough shape to be identified as to species.

One of the most conspicuous kinds of relics left by these ancient civilizations is their pottery. Whole pots can only be found by digging, but broken pieces in enormous quantities litter the ground around old habitations. Here, as in many other regions, pottery relics are as invaluable to the archaeologist as are index fossils to the paleontologist. An expert on the pottery techniques of different times and places often needs only a few broken bits of pottery to identify the culture that left them. But beyond its usefulness in recognition and correlation of cultures, the pottery of the Peruvian coast has another and much more unusual value. These potters did not limit themselves to the geometric shapes and abstract designs characteristic of the pottery of so many other Indian cultures. They shaped and decorated much of their pottery to represent a fantastic variety of real and imaginary things and happenings. As a result they have perpetuated a wonderful record, partly of fanciful legends and weird supernatural beings, but largely of how real people who lived in these oases looked and dressed, of their occupations and customs, and of the everyday objects that surrounded them.

MODELS OF CROPS

The small fraction of these pots which represent crop plants provide some of the oldest records of many cultivated plant species. Most are so beautifully made that there is no doubt as to the identity of the plant represented. Some were cast from molds made directly from real plants and are thus actually man-made fossils of the impression type. These fine pots were obviously intended for ceremonial rather than utilitarian purposes; they were placed in graves and perhaps used for harvest offerings. Certainly the ancient potters were strangely concerned with fruits, roots, and tubers, and curiously neglectful of flowers and other inedible plant parts. There is often a puzzling lack of connection between the abundance of actual remains of a crop and the number of its pottery representations. Cotton, an old and



important crop of the region, seems never to have been shown in the pottery. Other plants which are favorite pottery motifs make up an infinitesimal part of the actual plant remains.

The pots illustrated here are shown about 1/5 natural size. They are from several different coastal cultures: Nazca (figs. A, B, C, D) in the south; Cajamarquilla (figs. E, F) in the center; Mochicá (figs. G, H, J, N, O, P, R, T), and Chimu (figs. I, K, L, M, Q, S) in the north. Most are from the so-called early period, customarily dated at somewhat over a thousand years

ago, but the Chimu pots were made in the late period immediately before the Inca conquest. Some (figs. H, J, P, R) are in the Museo Arqueologico "Rafael Larco Herrera" on the Hacienda Chiclin near Trujillo. The others are in the Museo Nacional de Arqueologia in Lima. I am sincerely grateful to these institutions for courageously allowing me to take the priceless pieces out of their cases to photograph them.

Maize (figs. A, F, I).—Maize is not one of the most ancient crops of this area. Where it originated is still uncertain, but it reached the coast of Peru well over a thousand years ago, at about the time that pottery-making appeared. Both plant remains and pottery models show that it has been an

important staple crop in this area ever since, although not so dominant a basic foodstuff as it was in Mexico. It seems to have been much used here for making the native beer, for popping, and as a green vegetable.

Canna or achira (figs. B, K).—Cannas, much like our garden ornamentals but with smaller flowers, are older crops than maize in these oases and were probably domesticated near by. They are still grown in many valleys of Peru for their starchy rhizomes, which are edible and sweet when cooked, though full of fibers.

Soursop or guanabana (fig. J).—This and other Mochica pots show that two closely related tropical fruit trees, the guanabana and the cherimoya, were brought to the Peruvian coast in ancient times. Both were widely cultivated in the American tropics at the time of the conquest.

Lima bean or pallar (fig. G).—The lima bean is one of the favorite motifs in early pottery and textile designs from several of the oases. The crop must have had special ritual and economic value to these people. A rich variety of different seed shapes, colors, and markings are found among the vegetal remains. There is evidence that the ancient Peruvians used these beans to send code messages by adding artificial markings to the natural markings on the seeds.

Peanut or mani (fig. E).—The peanut arrived on the coast of Peru at least as early as maize and has been a fairly important crop ever since. The finding in these oases of archaeologic records of this plant settled an old argument over whether it originated in Africa or America. It now seems likely that it was domesticated somewhere in northeastern South America or the margins of the Caribbean.

Manioc or yuca (fig. O).—This crop is also ancient on the coast of Peru, although it must have originated far away, perhaps in the same region as the peanut. The famous bitter forms, from which cassava bread is made, were left far behind and only the less productive but more easily prepared sweet manioc reached Peru. It is still a common crop at low altitudes all through Peru, grown for its starchy roots which are eaten as a boiled vegetable.

Chile pepper or aji (figs. C, D).—Various forms of the chile pepper spread through the American tropics in prehistoric times and were among the oldest crops of this coast. Spanish accounts from the time of the conquest report that the Peruvians put aji in almost everything they ate and that their religious fasting consisted primarily in abstaining from the use of aji.

Potato (figs. L, M, N).—It is a little surprising that these ancient potters gave so much attention to the potato. Though sometimes grown on the coast, usually by planting seed tubers brought from the highlands, the potato

doesn't amount to much as a crop there. Its stronghold has probably always been in the cool Andean highlands behind the desert.

Other strictly highland tuber crops are represented on some of the coastal pots. One of those illustrated (fig. P) may show one of these, the ullucu, a plant not related to the potato but with very similar tubers.

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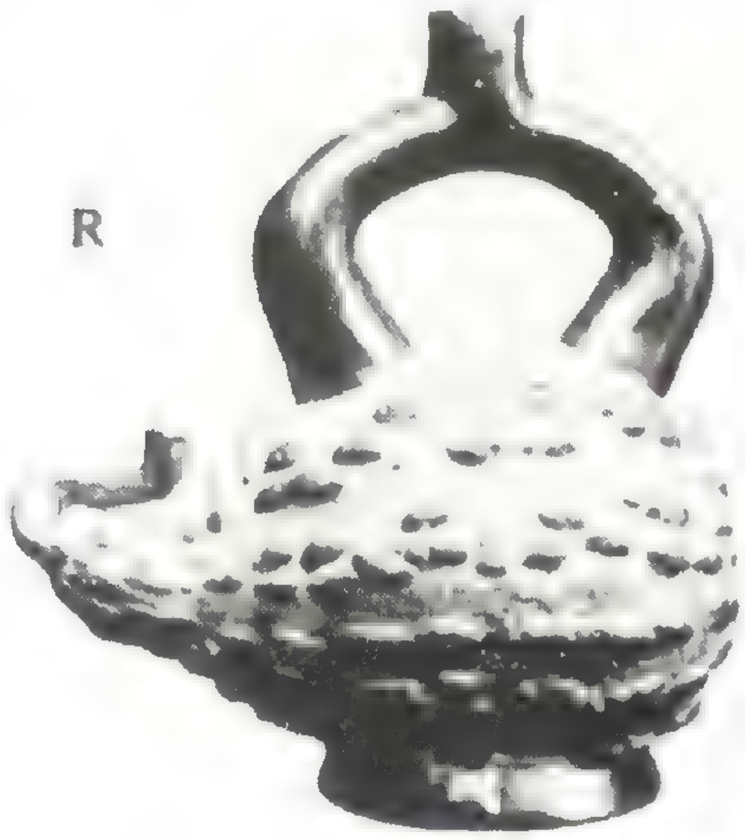
R

S

T

Squashes (figs. Q, R, S, T).—These pictures were examined by Thomas Whitaker and G. W. Bohn, of the U. S. Horticultural Field Station, La Jolla, California. They conclude that at least two, and possibly all, of these pots represent *Cucurbita moschata*. This is an extraordinarily interesting species of squash. It is reported among the crops of the earliest known prehistoric farming peoples of the southwestern United States. It is also ancient among the Maya. On the coast of Peru it has been traced back some 4,000 years, as far as any crop and farther than most.

Yacon (fig. H).—This tall relative of the sunflower was probably domesticated in some warm Andean valley. It is still grown on a small scale for a long way up and down the Cordillera. The fleshy roots are eaten raw and, like watermelon, are appreciated more as refreshment than as food. Yacon roots are sweet and juicy, keep well for weeks, and become even sweeter when left out in the sun. The early Spaniards found them a marvellous "fruit" to take on sea voyages. Quite a few of the roots have been found in archaeologic sites. Long before the Spaniards came, the people of this desert must have been taking the refreshing yacon along when they sailed out on the ocean in their *balsas* or travelled between the oases on foot.

The pots which have been considered here are some of the best crop plant models in two of the world's finest museums of Peruvian archaeology. However, they include only a fraction of the plant models already uncovered. The remarkable Peruvian pots have been deservedly famous for a long time and a lot of them are scattered around the world in countless private collections and museums. Among them are some which show different versions of the same crop species illustrated here as well as others which show entirely different crops. These will not be enumerated here, since the intent of this paper is simply to present a fresh sample, not an exhaustive summary of all the known plant models. More complete and more expert discussion of the wonderful archaeologic record of Peruvian crops can be found in various scientific publications, a few of which are listed below.

This sample is enough to show how much of our present knowledge of cultivated plants in ancient America is derived from the oases of Peru. This is partly due to the agricultural skill of the inhabitants. They must be credited with building a wonderfully advanced and diversified agriculture at an extremely early date. However, very few of their crops could have been their own creations, since few could have been derived from the local wild plants. Many of the cultivated species for which the Peruvian coast provides the very earliest records must have been domesticated in far-off regions by peoples who have left almost no other record of their accomplishments. Such crops must have had a long pre-archaeologic past before they were brought

into this desert to be mummified by the arid climate or modelled by a skillful potter.

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NOTES

In addition to being unusually attractive, the Chrysanthemum Show at the Garden this year includes several new features. Small-flowered varieties such as "Jean Hart" have been trained on a fan-shaped wire frame (a device frequently used in Europe to set off large chrysanthemum flowers), and the delicate little fans of yellow and green thus produced give the effect of small flowering hedges. As the focal point of the display, large screens similar to those used in California gardens to cut down the force of the wind were erected in front of the main collection of large-headed sorts. Behind these screens and backed up with a solid wall of greenery, the flowers of the specimen plants seemed almost to float in space, like floral lanterns decorating a garden party.

Conference on Cell Analysis.—In these days of scientific specialization men working in seemingly very different fields often discover that they are studying different aspects of the same fundamental problem. The Garden, as part of its contribution to science, has sponsored several informal conferences which have brought together groups of specialists to talk over some subject of mutual interest: quinine, yeast genetics, inflorescence structure in maize, and the like. On November 8 and 9 a small group was brought together to discuss the most effective methods of studying the chemical composition of plant and animal cells. Dr. Barry Commoner, of the Henry Shaw School of Botany, and Dr. Oliver Lowry, of Washington University School of Medicine, were joined by Dr. David Glick, professor of physiological chemistry at the University of Minnesota, Dr. Alfred Mirsky, of the Rockefeller Institute, Dr. Marcus M. Rhoades, professor of botany at the University of Illinois, and Drs. Davis Goddard and Ralph Erickson, of the botany department, University of Pennsylvania. Dr. Erickson is a former student in the Shaw School of Botany who received his doctorate from Washington University in 1944.

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Volume XXXIX December, 1951 Number 10

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EXOTIC FOLIAGE PLANTS FOR MODERN INTERIORS

LADISLAUS CUTAK

When the American Society of Landscape Architects met at the Garden earlier in the year a check-list of tropical and subtropical plants suitable for landscape purposes was prepared and distributed to the members. The architects showed great interest in these plants, especially after they were shown living examples of them in the Garden greenhouses, and some suggested that the list be elaborated upon for their use. With this in mind, an attempt is being made here to furnish information on exotic foliage plants for the home, office, and factory. Probably at no other time has so much emphasis been placed on plants for the interior as at the present. This is due chiefly to the fact that the extensive use of large glass windows and walls in modern buildings brings in an abundance of light and makes it possible to have gardens indoors.

In utilizing plants for decorative purposes one should first learn which ones are suitable for the particular spot. Another thing to take into consideration is that plants, like pets, will need water, food, and protection. Limited

The popular picture window in the home, featuring Nephthytis, Dieffenbachia, Dracaena, Pandanus, Calathea and Begonia. Window faces east.

space prevents us from giving a lengthy discussion of the needs of the individual plants, and it is recommended that you obtain one of the reliable garden dictionaries, such as Bailey's "Cyclopedia of Horticulture" and Norman Taylor's "Garden Dictionary," for more detailed information. Any one who has anything to do with plants, especially if earning a living by them, should possess one of these standard works for reference.

In the average home, windows are probably the best spots for growing plants, and additional space can be achieved by building shelves into the window. They can also be grown in wall pockets, on mantels, tables, or

Plants grown in the window of an average home, using clay pots and novelty containers.

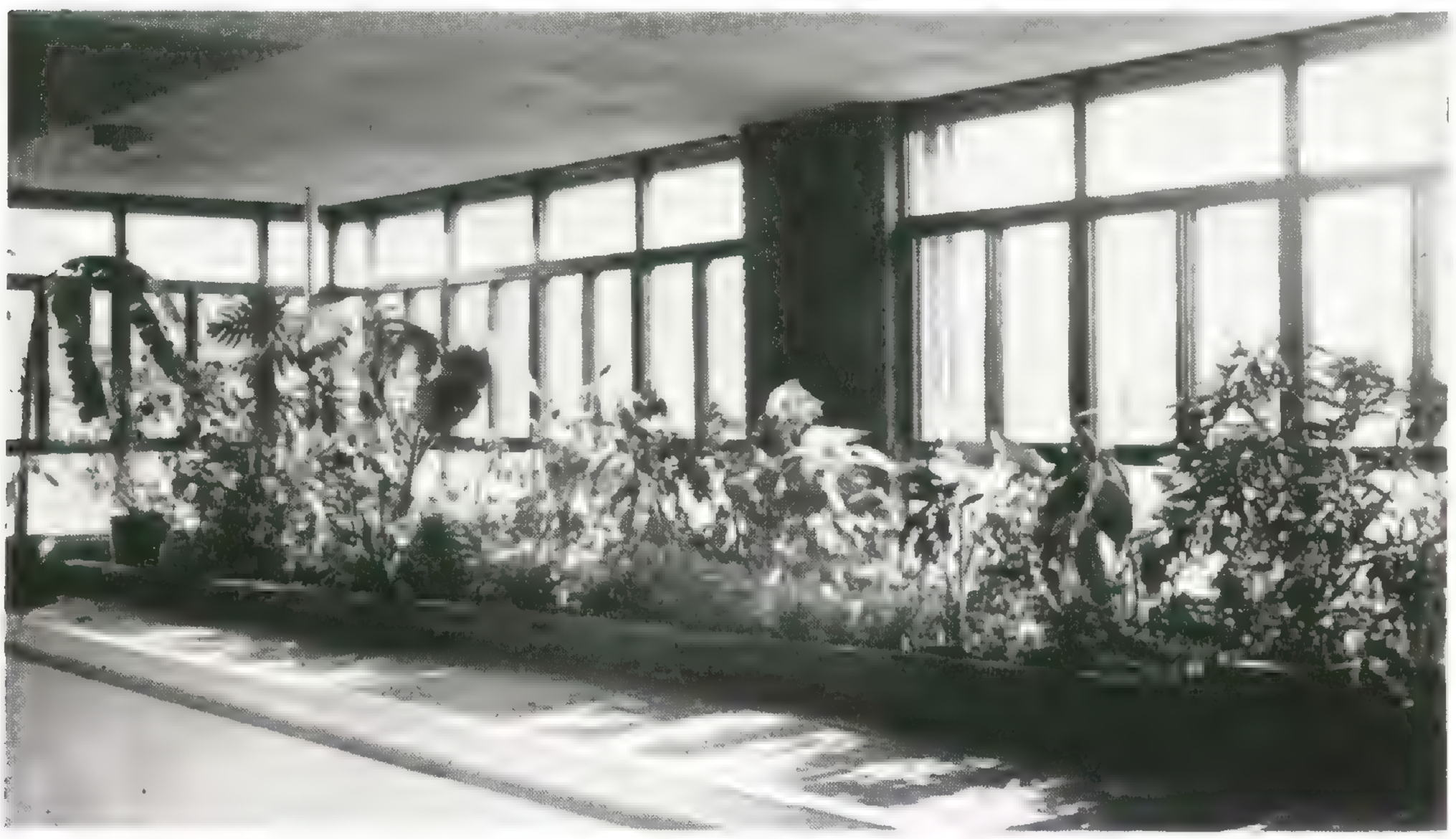
near fire-places, provided some light is available during a part of the day. Actual sun isn't necessary. In more spacious modern homes, planting-boxes are often used to separate rooms—sometimes built right on the floor, elevated on masonry, or placed atop pieces of furniture. A glance through house and garden magazines will reveal where plants can be placed as part of the living scene in almost any kind of a dwelling. Foliage plants need not be confined to homes. There is need for them in offices, display rooms, hospitals, restaurants, hotels, and even in factories. Penthouses, roof-gardens, open and enclosed patios, and studios are all places to be decorated with living plants.

A typical modern home with a permanent garden right in the kitchen. Home of the T. N. Kohlers in Kirkwood.

Pottery bowls and dishes usually serve as containers for growing plants in the home. There is a great variety of containers to choose from, to fit everyone's pocketbook. Boxes of various sizes and materials can be used in which to plunge the pots, or the plants may be set directly in the boxes. In spacious homes, studios, and the like, permanent planting-boxes of brick or flagstone may be built right on the floor. An asphalt coating on the concrete bottom is necessary to make the box water-tight, and coarse gravel, cinders, or sand should be placed to a depth of about one third the height to absorb seepage. A planting-box which has become quite popular in recent years is made of cypress or redwood, mounted on castors, and furnished with metal draining pans. This type is good for patios and terraces, stores and display rooms, and spacious porches and sunrooms, for it can be easily wheeled to a prominent position or relegated to the background when not needed.

Plants grown indoors will require regular waterings, and the amount of water will depend upon the type of plant, the size of the container, and the surrounding atmosphere. The technique of watering is the trickiest part of gardening, but here again a good garden book can come to the rescue. Some plants, such as many cacti, have to dry out completely before the next watering; others wilt and ultimately die if they are allowed to get dry. It will be wise to observe the plants for a few weeks to determine how fast they dry

out in the particular location. If rooms are kept at high temperatures and the air is dry, the chances are that most of the jungle plants will require frequent waterings. On the other hand, irregular watering in warm dry air will suit most of the cacti and other desert plants. Some plants, such as Ivy and Philodendron, will not mind if their roots are kept in water for weeks. Watering from the bottom assures the right amount of water at a constant rate. This is accomplished by immersing the pots in water up to the rim, and, after the soil is saturated, draining off the surplus water. Water-filled saucers will also do the trick, perhaps more slowly. Under no circumstances should water be kept in the saucers, as this has a tendency to water-log the soil and to cause root rot. When potted plants are to be plunged in planting-boxes or in larger containers it is a good practice to surround the pots with



Indoor swimming pool in the Benjamin Fry home, the bordering beds featuring such exotics as the Banana, Giant Elephant-ear, Hibiscus, Acalypha, Ficus, Coleus, etc.

sand, peatmoss, sphagnum, or other absorbent material, which should be kept moist. The porous flower pot will absorb water from this damp medium.

In order to grow fine healthy plants the right kind of soil should be provided. Some plants require a rich soil with a proportion of leaf-mold and decomposed manure; others thrive in acid soil; and still others prefer a light mixture sprinkled with sand. Here again garden dictionaries should be consulted when in doubt. Desert plants, including the bizarre cacti, usually thrive in a light gritty soil composed of sand, gravel, or other coarse material, while acid-loving plants need a greater amount of leaf-mold and peatmoss. Balanced plant food given at regular intervals is recommended, but only during the active growing season. A number of concentrated plant foods are available, either in tablet, powder, or liquid form.

Plants should be inspected frequently for any sign of insect pests, for if insects are allowed to get a start they are not easily eradicated. Red spiders are among the serious pests of ornamental plants. They produce a speckled condition on leaves and flowers, and a severe infestation causes the leaves to drop. A dry warm atmosphere is conducive to their multiplication. These tiny mites spin fine strands of silk, particularly on the underside of the leaves, which is not readily detected until the infestation is severe. Daily syringing with water, dusting with sulphur, or applying specific insecticides will aid in their control. A similar pest is the thrips whose presence is rec-

Atmospheric conditions, such as found in conservatories, permit exuberant growth to develop in the indoor patio of Edwin Lemp's home on the bluffs of the Meramec near St. Louis.

ognized by the small black dots or excrement left where they feed. They are small, slender, blackish insects which hop when disturbed. Thrips rasp the plant tissues and then suck up the liberated juices. The characteristic injury is a blotching and streaking of leaves, and even disfigurement of flower petals. Thrip control is effected by the applications of nicotine sulphate and soap, or Parathion. Parathion possesses residual action for a long period, but must be handled very carefully as it is highly toxic.

Mealybugs are probably the most serious pest. They are soft-bodied insects which suck the plant sap with their needle-like mouth parts. They are made conspicuous by their protective cottony white covering. Ordinarily,

Another view in the enclosed patio of Edwin Lemp's home. Permanent plantings include some of the choicest foliage plants available.

mealybugs cluster on the branches and the undersides of leaves causing a yellowing of the leaves, defoliation, and finally death of the plant. Volck is a good insecticide to use on them, and if the infestation is mild the colonies can be eradicated by touching them with a small brush (or a wad of cotton on a toothpick) dipped in grain or rubbing alcohol. Mealybugs excrete a honeydew which attracts ants, necessitating the control of ants also. Soft scales and armored scales are commonly found on house plants and are often hard to control. The latter possess a hardened shield or scale above the body. They too feed on many plants by sucking the juices. A light-oil emulsion is quite effective, especially when the young are still crawling about.

Aphids or plant lice suck the plant juices and cause stunted growth. They like to congregate on young shoots and leaves and flower buds, causing a curling of the leaves and preventing normal opening of the flowers. The

insects are soft-bodied, greenish, blackish, yellowish or brownish, and the size of a pinhead. They are about the easiest to control although repeated applications may be necessary. A nicotine sulphate spray is recommended. Root aphids work on the roots of a large variety of plants, and seem to be prevalent where soil is allowed to become dry. Cacti, succulents, and palms are favored hosts. Plants with root aphids are stunted and the foliage is yellowed. Infected plants should be taken out of the soil and dipped in a nicotine solution; or when too large for this operation, the soil near the base of the plant should be saturated with nicotine. Where only one plant is affected in a collection, it is always best to remove it from the rest until all signs of infection have vanished.

Foliage plants are often disfigured by a drying off or browning of portions of the leaves. This may be due to a food deficiency; to burning by exposure to brilliant sun or strong insecticide; or, more likely, to high room temperatures and lack of water in the soil. The unsightly foliage should be trimmed with scissors, and, if possible, the leaf shaped to its characteristic form.

Since dust will settle on foliage plants it is advisable to wipe off the leaves with a damp cloth. Smooth leaves, particularly those of Ficus species, can be kept glossy and shining by wiping with an oiled rag.

SUITABLE TROPICAL PLANTS

All the plants described in this article have their origin in the tropics and were chosen as the outstanding examples of decorative material for the modern interior. Since some plant families contain many outstanding individuals, the plants are dealt with under the name of the family. The Aroids, for instance, which contain numerous ornamental plants, will be considered first.

Aroids.—The Aroid family (botanically Araceae) is represented in almost all the warmer regions of the globe, but only a few of the many genera are found in the trade. These few, however, are grown today in countless millions. The ones commonly met with are Anthuriums, Aglaonemas, Dieffenbachias, Monsteras, Nephthytis, Philodendrons, and Syngoniums. *Monstera deliciosa* and *Philodendron cordatum* are apparently the most popular aroids in existence. Glance through any house and garden magazine, and you'll find these plants represented in most illustrations depicting interiors. *Monstera deliciosa* is a large-leaved foliage plant, excellent as a pot plant for almost any location. If given room for expansion it assumes a scrambling mode of growth and is then especially adapted for creeping up a brick or concrete wall, massive rockwork, etc. It can be trained to climb a moss-covered pole, and since it grows fast and prefers a shaded location it has become first choice with interior decorators. The stems often become as stout as a man's wrist and will produce numerous aerial roots often as thick as one's finger. The leaves are outstanding for their bold effect. At first the leaf is light green

and beautifully rolled up like a roll of paper. Shortly, it begins to unfold into a very broad heart-shaped blade, up to 3 ft. long by 2½ ft. across. It is deeply slashed from the margin halfway to the broad midvein and has several oblong perforations, which account for the plant being commonly called "Swiss-cheese Plant." A mature vine will produce a number of large white to cream-colored "calla-like lilies," followed by large cone-like fruits with a delicate pineapple-banana odor and an agreeable flavor.

Monstera deliciosa fits well in almost any location. A soft green fluorescent light enhances this window in the Robert Kofron home at night.

Anthuriums are usually epiphytic in habit, although a good many of them will grow as terrestrials and as such are often treated in the conservatories at the Garden. There are over 500 species described, most of them from northern South America, particularly Colombia and Venezuela. The ones with the colorful "blooms" (technically spathe and spadix), such as *A. Andreanum* and *A. Scherzerianum*, are usually known as Flamingo Anthuriums, while those with the less showy and often inconspicuous floral spikes, as *A. Hookeri* and *A. Olfersianum*, are referred to as Tail Flowers. Flamingo Anthuriums prefer more humid and warmer surroundings and are grown extensively in California and Hawaii for the cut-flower trade. The Tail Flowers are much more easily managed and are ideal for shaded locations. Some Anthuriums produce a short caudex or stem, while others become large scandent vines. The leaves of Anthuriums are very variable in form and size, with a leathery texture which makes the plants excellent house subjects.

Planting-box in entrance-way at the Col. C. P. Bobe home in Manchester. Variegated Scindapsus *(Pothos aureus)* climbs a moss-stick while Dumb-cane and Sansevierias fill the box.

The Heartleaf Philodendron has been growing in Gus Bantel's living-room for several years and now extends into his bedroom.

The showiest-leaved forms belong to *A. Veitchii*, *A. Warocqueanum*, and *A. crystallinum*, but these require a warm humid atmosphere and special culture. They are more suitable for conservatories and enclosed patios. Probably the most-striking species is *A. Hookeri*, whose huge leaves have a characteristic bird-nest effect.

The genus *Philodendron*, with 200 or more species, probably contains the most popular house plants today. Less than a fifth of them are available in the trade but these have proved able to withstand minimum care. *Philodendron cordatum* is a climbing or trailing species with small heart-shaped leaves. It has proven so adaptable that it is found in almost every home. Ordinarily, small plants are displayed in hanging pots or wall pockets, but they are also used in dish gardens, terrariums, and novelty containers, where they either hang gracefully, trail along the ground, or climb upon trellis work. It is believed to be the most foolhardy vine in existence. A friend has planted it in a window-box from which it climbs up wires to the ceiling

and then condescends to crawl overhead all over the room. When this vine is allowed to grow tall, as in the Garden conservatories, it will produce very large leaves and look unlike the small plant seen in the home. Occasionally, plants of this species flowered in the Palm House, and when studied by the author seemed to be not the true *P. cordatum* as originally described from Brazil, but perhaps *P. oxycardium* of Mexico . . . but try to get the grower to make the change!

There are a number of Philodendrons in the trade, such as *P. hastatum*, *P. Imbe* and *P. sanguineum*, which possess large arrow-shaped leaves. They are sturdy individuals and, given room to climb, will make excellent specimens for corners and backgrounds. For bold tropical effect, *P. Melinoni* and *P. cannaefolium* should not be overlooked. The former bears large, long-stalked leaves which spread out from a short thick shaggy stem. The latter is a short-stemmed species with short, stout petioles that resemble the pseudobulbs of certain orchids. It is not as heavy as *P. Melinoni* but equally attractive. *P. Wendlandi*, with thick swollen petioles and leathery green foliage, resembles a Bird-nest Fern. Although it has only recently been introduced into the trade, it has become very popular. One of the nicest of recent im-

Billbergia and Philodendron are excellent for sunless spots such as mantels.

ports is *P. Ilsemanii* of Brazil, with oblong-cordate, dark green leaves splashed with white. The Ecuadorian *P. Mamei* is a good companion to it, its corrugated heart-shaped leaves overlaid with silver. *P. Selloum, P. dubium, P. pinnatifidum,* and *P. bipinnatifidum* offer attractive leaves that are deeply cut and lobed. Even though *P. erubescens* does tend to grow rank, like many of the Philodendrons, smaller plants are excellent pot material. The cordate-sagittate leaves are glossy on both sides, and a pleasing coppery hue predominates on the underside. *P. verrucosum* has beautiful cordate satiny

Flagstone planting-box separates living- from dining-room in the Frank Sieloff home. Utilizes Episcia, Philodendron, Monstera, Dieffenbachia, Anthericum, Cissus, and Sansevieria.

leaves, the upper surface metallic olive-green with prominent lighter-colored veins, while the undersurface is maroon-colored between the pale green veins. The red petioles have a green pubescence. However, unless the plant is grown in a moisture-laden atmosphere it loses its leaves. When *P. Andreanum* is trained to climb upon a pole, the very long dark velvety green-irridescent leaves are very striking. It will not thrive in dry cool places.

Syngonium, Nephthytis, and Scindapsus are climbing aroids which contain some outstanding members. The most popular is *Scindapsus aureus*

from the Solomon Islands, generally sold under the name of *Pothos aureus*. Grown as a pot plant, it remains small with glossy, green and yellow foliage and is used as frequently as the Heartleaf Philodendron in hanging baskets, dish-gardens, and window-boxes. When allowed to climb up a tree trunk, pole, post, or wall it will attain an immense height. Several silvery and golden sports have been developed from it. *Syngonium podophyllum* and its variegated types are used frequently in sunless spots. The most popular of the Nephthytis is the African *N. Afzelii.*

Aglaonema, Dieffenbachia and Schismatoglottis are excellent pot plants and do well in homes, stores, factories, or other places where dry atmosphere prevails. They can stand a great deal of neglect but should be watched for red spider and mealybug. The most familiar of the group is *Aglaonema simplex*, commonly known as Chinese Evergreen. However, it is neither Chinese nor an evergreen like the Pine, but hails from Borneo. It isn't beautiful or particularly striking, its popularity resting on its ease of culture and the fact that it grows equally as well in water as in soil. Two beautiful species of Aglaonema in the trade are *A. commutatum* and *A. Roebelini.* The former comes from the Celebes and is dwarf in habit. It has lance-shaped leaves splotched with gray-green, and produces tight clusters of scarlet berries. The latter, sometimes sold under the name of Schismatoglottis, has attractive gray-green foliage smeared with dark green.

Dieffenbachias are known as Dumb-canes, because if a piece of stem touches one's tongue, it will cause the organ to swell and render one speechless until the crystals are thoroughly dissolved. Dieffenbachias possess thick fleshy stems ringed by leaf scars, and handsome broad leaves, mottled, spotted, or striped, with white, cream, or yellow. The plants tend to become leggy and top-heavy with age but may be easily cut above the base and kept to a desired height. All Dieffenbachias have proved to be excellent decorative subjects. *Dieffenbachia picta* is perhaps the easiest propagated and grown. It has green oval leaves generously sprinkled with greenish-white spots. The most outstanding Dumb-cane is the sport, "Rudolph Roehrs," developed from *D. picta.* The color of the leaf is yellow-green to almost white, edged with green. *D. amoena* is a robust Colombian species now coming into prominence.

Fig Family.—The Fig family contains very ornamental plants of easy culture. The three most common species, *Ficus elastica*, *F. lyrata* and *F. utilis*, have large leaves and are excellent subjects for patios, stores, factories, or wherever bold effect is needed. Usually, the plants are restricted to a single stem, but branched plants can be developed by pruning or pinching the points. The India Rubber Tree, *F. elastica*, has probably been grown by every house-plant devotee, the variegated form being the most desirable. A

noble example of the variegated Rubber Tree has been growing in our Economic House for a number of years. The Fiddle-leaf Fig, *F. lyrata*, is a striking plant for pot or tub culture. The leaves grow very large and are shaped like the back of a fiddle. Remember to keep this plant well supplied with water and the leaves will remain all the way down the stem. The Zulu Fig, *F. utilis*, grows equally as well as *F. lyrata*, and bears extremely long leaves which are beautifully veined with white. There are a number of small-leaved Figs which remind one of Citrus or Laurel trees. The most graceful of them is *F. Benjamina*, with long drooping branches that are covered with small dark green leaves. *F. nitida* is an upright grower, producing a compact head of foliage quite similar to *F. Benjamina*. *F. pumila*, native to the Orient, clings closely to walls and makes a beautiful tracery with its small rounded green leaves. The entire northern brick wall in the Linnean House is covered with the Creeping Fig.

Indoor patio suitable for hotels, museums, and luxurious apartments. Skylight permits plenty of light for maximum development of plants. View in Bird House, St. Louis Zoo.

CROTONS.—Some of the showiest shrubs for well-lighted corners are Codiaeums. One great advantage is that they can be confined to small pots for a long time without any injury. They are tender plants and should be grown in a very moist atmosphere to prevent red spider from gaining a foothold. Plenty of light is also necessary in order to bring out the rich markings of the leaves, although a few species will hold their rich colors even in the shade. The Crotons prefer an open and porous soil, a warm atmosphere, and ample watering. One of the most beautiful varieties is "General Paget," which has immense green and yellow leaves. Another striking variety is *C. Reidii,* whose large leaves are striped with cream and shades of pink. Leaves of Crotons vary as to size, shape, and coloration. Some have small myrtle-shaped leaves, others oak-shaped; some are very broad, others long and narrow, curled, spiral or flat; brilliantly veined; spotted, mottled or variegated and flushed or suffused with all the pastel shades.

CONIFEROUS EVERGREENS.—Small coniferous evergreens grown in pots make excellent table decorations, and large ones in tubs are suitable for patios. They thrive in good fibrous loam mixed with sand. One of the most striking is the Norfolk Island Pine, *Araucaria excelsa,* whose dark green, awl-shaped leaves are densely packed on the horizontal or pendulous branches. *A. Bidwillii,* with lanceolate, leathery, spiny leaflets, is also attractive. Podocarpus is a beautiful coniferous tree with horizontally spreading branches and pendent branchlets. It may be grown as a shrub and is useful in background effects. Small plants are excellent window-box subjects.

LILY FAMILY.—One would hardly expect to find foliage plants in the Lily group but there are quite a few that can be classed as spectacular subjects, for instance, the Dracaenas and Cordylines. They vary greatly in size and general appearance. The best-known is *Dracaena fragrans* from Tropical Africa, whose arching, corn-like leaves are produced in a symmetrical rosette. It will attain a height of 15 feet if allowed to grow, but can be topped and kept to a desired height. Like most of the Dracaenas, new plants are easily propagated from the stems, which should be cut in small pieces, placed in light soil or sphagnum, and allowed to form roots and new shoots. There are two horticultural varieties of *D. fragrans: Massangeana,* with a broad yellowish stripe down the center of each leaf; and *Lindeni,* with marginal stripes. *D. Rothiana,* with hard and tough green leaves, resembles *Yucca elephantipes* and looks best when grown as a short-stemmed plant. *D. umbraculifera,* as its name suggests, gives the appearance of an umbrella, so closely set are the long, narrow, dark green leaves. The best varieties for the home are, of course, the dwarf kinds such as *D. Godseffiana, D. Sanderiana, D. elliptica,* and *D. concinna. D. Godseffiana* is an attractive little shrub

Spacious stairway window recess in Architect Bernard McMahon's home.

with oval, deep green, yellow-spotted leaves borne on wiry stems. Scarlet berries follow the blooms and persist on the plant for a long time. *D. deremensis*, with its white-striped varieties, is a highly decorative plant which may be used in dish gardens. It grows to a height of five feet and would be suitable for planting-boxes in spacious homes and offices. Cordylines are closely related to Dracaenas and often are sold under that name. An East Indian species, *C. terminalis*, with stalked, lance-shaped, crimson leaves, is one of the best, and there are many beautiful strains which have been selected from it. The Hawaiians use the leaves of *C. australis* for their hula skirts.

The Aspidistra is a broad-leaved evergreen plant. Known as the Cast-Iron Plant, it is one of the few house plants which seldom fail, whether kept hot or cold, in smoke-filled taverns, hotel lobbies, hall-rooms, basements, or any other poorly lighted places. However, it does best in rich leaf-loam and sand. The long dark green leaves should be washed occasionally to impart a shine. Aspidistra is chiefly propagated by suckers.

Sansevierias thrive in any kind of soil, with either a liberal or scanty amount of water, and are relatively free from insect attacks. At least fifty species have been described, although only a few are found in the trade. Interest in Sansevierias has risen in the past few years, and an attempt has been made to introduce a few more kinds. S. *trifasciata* and its golden-striped variety, *Laurentii*, are the best known, being listed in catalogues under S. *zeylanica*. However, the true *zeylanica* is almost unknown in cultivation, although it was one of the first to be described. S. *trifasciata* produces 2–6 leaves to a growth, and its beauty lies in the new leaves which are beautifully marked on both sides from base to apex with alternate bandings of silver-green and dark olive-green. The golden-striped variety, *Laurentii*, is more attractive since it provides a color note. Leaf cuttings, of course, revert to the typical green species, but a number of sports have come from it, and one of the best is the patented "Bantel's Sensation" which hit the market a few years ago. It is a stiffly erect plant with slender sword-shaped leaves streaked with silver-white. S. *longiflora* is heavier-textured than any of the above. Its foliage is dull blackish-green marked on both sides with blotches and spots of paler green in irregular transverse bands. A glorified version of it is being grown in the South African House and for vigor and bold effect it has no peer. Each growth produces 3–8 large, leathery leaves marked with prominent zigzag bands of pale and dark green, and red brown margins. The leaves are remarkably broad—up to 8 inches. This should prove a wonderful plant for tub culture in patios, hotel lobbies, etc. As yet it has not been determined if it is a sport from S. *longiflora* or a distinct species. There are a number of cylindric and semi-cylindric Sansevierias useful for modern interiors. It should be borne in mind that the leaves of many Sansevierias will grow up to four feet or more in length and for smaller places, younger plants should be used. There are also several dwarf types; S. *aethiopica*, S. *arborescens*, S. *subspicata*, and S. *Hahnii*. S. *aethiopica* produces about 25 short and narrow leaves to a tuft, all with a bluish hue; S. *arborescens* looks unlike a typical Sansevieria, with thick, stiff, narrow, green leaves extending nearly horizontally from the stem in all directions and assuming a tree-like appearance; S. *subspicata* is a deep green species, with fairly wide leaves that seem to hug the ground; S. *Hahnii*, a patented plant, is probably the pygmy of the genus. The comparatively short broad leaves are arranged in a bird-nest fashion. S. *aethiopica*, S. *subspicata*, and S. *Hahnii* are excellent border plants for beds in patios, conservatories, in planting-boxes of all kinds, or as pot plants.

Another member of the Lily family which makes an excellent border subject is *Mondo japonicum*. It is a dwarf, very dark green, grass-like plant which prefers shade and can be used in unheated enclosed rooms and porches.

Contemporary home of Col. Charles P. Bobe, in Manchester, Mo., showing a planting-box in the living-room where plenty of light from the glass side-wall makes for successful growing of succulents and other small plants.

There is a variety with yellow striped foliage.

Closely allied to the Lily family is the Amaryllis family, several members of which can be grown in a home. By far the easiest of culture are the Clivias. As foliage plants they are excellent, but when they condescend to bloom they really are a glorious sight. They differ from Amaryllis in having evergreen foliage which persists for many years. The long deep-green strap-shaped leaves grow in two-ranked tufts from which arise large clusters of brilliant flowers varying from apricot through orange to scarlet. The best-known species is *Clivia miniata* from South Africa, and several strains of it are now in the trade. Clivias can be grown in shaded locations and can even stand a certain amount of neglect. They will do particularly well in planting-boxes near entrance-ways or where used to separate one room from another. They like a well-drained soil of fairly heavy texture which need not be renewed for a long time. There will be a tendency for the roots to come up above the soil, but this should cause no concern as it is perfectly natural. Once established, Clivias need not be divided because the bigger the clump the more profuse the flowering will be. Strong sunlight is not to their favor nor too much water. In fact, the plants can be injured permanently by either. It has also been found that cold weather will not hurt them unless it persists for a long period. Clivias, then, are highly recom-

mended for tough spots in your home, for the shady porch, and for offices and factories.

Another good Amaryllidaceous subject for tub culture to decorate patios, entrance-ways, conservatories, studios, and spacious office buildings is the Weevil Plant, *Curculigo capitulata*. It resembles palm-grass, with its broad, dark green, deeply ridged leaves arising from short stout stems. It prefers shade and a good supply of water.

Begonias.—The richly colored flowers, coupled with the beautifully marked foliage, have endeared Begonias to all house-plant enthusiasts. As a rule, Begonias are free-growing and free-blooming. Some of them will require special kind of attention, but a few will stand a certain amount of abuse. Moist air is recommended but not entirely necessary for most species, and where the rooms are hot and dry they should be grown in a terrarium. Large terrariums can be made a part of a decorative scheme in the modern house. Any one wishing to use Begonias with a reasonable amount of success should refer to books devoted to this group, since it would be impossible to cover the subject adequately in one paragraph.

Ferns.—Delicate foliage is a characteristic of ferns, which generally are found in shaded places in moist forests, beside waterfalls, and in humus-filled pockets on rocky ledges. Ordinarily, they do not like the dry air of our homes but a few make ideal house plants. Some good specimens of the Boston Fern, *Nephrolepis exaltata bostoniensis*, are often found in barber-shop windows. The House Holly Fern, *Cyrtomium falcatum*, is more tolerant of house conditions than any other member. Species of Pteris seem to do well in pots on a table if the soil is not allowed to dry out. Staghorn Ferns (*Platycerium* spp.), grown on wooden blocks and hung in patios or porches, will do surprisingly well. Dip these ferns in water frequently to keep them from drying out. The large Mexican Tree Fern, *Cibotium Schiedei*, with gracefully curving lacy fronds of the brightest green, is frequently used for stage decorations. Probably the most striking and unique is the Birds-nest Fern, *Asplenium nidus*, whose broad bright green leaves are arranged in circles around a central core of stem.

Palms and Cycads.—These plants lend character and distinction to the tropical scene and should be employed in patios, lighted lobbies and display rooms, or spacious entrance-ways. The most serviceable palm is the Kentia from Lord Howe Island. Florists keep this palm on hand as a decoration for weddings, balls, banquets, and other special functions. No other palm could stand the rough handling that the Kentia takes. Palms, in general, require a fairly heavy, rich soil and will do better in reduced light. The leaves are apt to collect dust and should be sponged off occasionally. Many of the palms do not acquire the graceful character until the adult stage. A number

of table palms have come into prominence since *Neanthe bella* was introduced into the trade in the late thirties. All of these are of Chamaedorea affinity and reach full development in 6–8 inch pots. Palms to be used as pot plants include: species of Caryota, whose bi-pinnate foliage resembles so many fish fins; Actinophloeus, Heterospathe, Cocos, Howea, and Chrysalidocarpus—all slender-trunked with graceful curving foliage; and some of the Sabals and Thrinax which display dwarf fan leaves.

Cycads are often referred to as palms, but really they are the most primitive of the living gymnosperms. They grow slowly and as small potted or tub specimens are excellent for well-lighted places, although some do well in light shade. *Cycas revoluta*, known as Sago Palm, is probably the best known, possessing stiff fern-like leaves in a crown at the top of the trunk.

Bromeliads are some of the finest of all house plants. Water must be kept in the cups at all times to insure success.

BROMELIADS.—The Bromeliaceae, a family of about 1800 species, contains some of the finest of all house plants. Interest in them is mounting rapidly, so much so that a Bromeliad Society was organized in 1950. A typical bromeliad is formed of a rosette of leaves, either loose or compact, of diminutive or massive size. The leaves may be grass-like or widely strap-shaped, rigid or quite flexible, smooth or rough, short or elongated, brightly colored, often mottled, marbled, striped or spotted, with or without marginal spines. The inflorescence is often spectacular and sometimes remains so for several months. Bromels grow in soil or perch on trunks and branches of trees, and even on rocks in their native home, which is tropical and subtropical America. They store a supply of water in the cups formed by the leaves and, since the nutrients are taken in through the leaves, instead of the roots, it is necessary to keep water in the cups at all times. Most of the epiphytic bromels do well in fibrous peat or a light soil mixture of decomposed leaf mold, some

cow manure, and sand. The terrestrial types from desert regions can be grown like the cacti. You will find the bromels very adaptable in almost any part of the house provided some light can be supplied during a part of the day. There is an infinite variety of species in this family, only a few of which there is space to list here. (The reader is referred to a more extensive work "Fascinating Bromels" in the September 1945 Garden BULLETIN.) *Aechmea fasciata* is a living marbled vase from which issues a bouquet of pink and bluish flowers on the order of a colonial bouquet. *A. Weilbachii*, with bronze-red leaves and a bright floral stalk, is one of the best growers and easiest propagators. *Billbergia thyrsoidea*, a bright green, fast-growing, foot-high rosette with a dense torch-like inflorescence of bright scarlet flowers, is a good subject. *Neoregelia marmorata* and *N. spectabilis* are two old-fashioned broad-cupped species that should be included in collections of house plants. The first has leaves heavily blotched with violet-carmine on both sides, while the second is readily recognized by the painted-fingernail blotch at the tip of each leaf. *Nidularium Innocentii* forms a green nest-like rosette, the central leaves of which become bright red when the plant decides to bloom. There are two striking varieties of it: *striatum*, whose leaves are striped with unequal yellow lines; and *lineatum* with much finer alternate green and white lines. *Tillandsia Lindeni*, with an elliptical to fan-shaped pink inflorescence and deep purple flowers, and *T. Lindeniana*, with a similar but more elongated inflorescence, are the most outstanding bromels. The latter is now in the process of having its name changed and may have to be called *T. cyanea*.

CACTI AND SUCCULENTS.—Modern interiors exposed to an abundance of natural light are inducements for growing the bizarre cacti and succulents. These plants represent such a large and diverse group that they can only be touched upon here, but there are many good books on desert plants from which complete information may be obtained. (See also the December 1950 Garden BULLETIN). In the warmth of a well-lighted window they look exceedingly attractive, and because of their slow growth a great number can be accommodated in a limited space. There are hundreds to choose from in all imaginable forms and in sizes ranging from tree-like to tiny balls. The tall, fluted Torch Cacti (*Cereus* spp.) and the cactus-like Spurges (Euphorbias) make good pot or tub specimens for use in corners of modern offices where glass blocks supply light source. They will also fit in very nicely in large picture-windows. A good symmetrical fast-growing succulent is the arborescent *Euphorbia lactea*, with wavy, marbled, triangular branches. The crested form is highly sought because it looks like a piece of carved jade.

Aloes are handsome subjects, but some will need lots of room for expansion. The closely related Gasterias are much smaller and are character-

ized by darker green, thick, fleshy, tongue-like leaves in two-ranked series. The diminutive Haworthias are living jewels excellent for dish gardens or terrariums. Kalanchoes give brilliant touches of color, especially the bright-flowered *K. Blossfeldiana.* The flowers usually appear in dense clusters.

Miscellaneous Plants.—Various citrus fruits grown in large containers have long been used in patios, conservatories, sun-porches, etc. There is nothing more attractive than a dwarf tree heavily laden with colorful oranges, tangerines, kumquats and lemons. Many of them are perfectly adapted to tub culture and bear both flowers or fruit almost all year around. The soil should be a moderately heavy loam to which a liberal amount of decayed manure and sand has been added. During the growing season, some liquid manure should be regularly supplied. *Pittosporum Tobira* is a worth-while tree which can withstand a certain degree of cold. It is densely foliaged and can be trained as a small shrub or a hedge. It bears leathery, grayish-green leaves and an abundance of fragrant white blossoms. A variegated form is very ornamental. This plant prefers a well-drained fibry loam medium and a good supply of water. The Silk Oak, *Grevillea robusta,* is a rapid-growing tree with beautiful fern-like leaves, dark green above and silvery below. *Schefflera actinophylla* has become a standard decorative plant in recent years for use in dark lobbies, entrance-ways, etc.

Among the good small plants are the numerous Ivy varieties which can be trained to trellises, used as creepers in window-boxes and other large containers, suspended in hanging-baskets, or grown as pot plants. The creeping Fittonias are excellent for terrariums, but also can be grown in patio beds or as ground covers in large planting-boxes. *F. argyroneura* is a dwarf compact species with vivid green leaves transversed by a network of pure white veins. *F. Verschaffeltii* is an elegant species with dark green leaves and red veins, and much the easier of the two to grow. Calatheas and Marantas are closely related plants in the Marantaceae family. They prefer humid greenhouse conditions, but a number of them can be grown as pot plants. One of the showiest is *Calathea zebrina,* with leaves of velvety light green barred with blackish-green and purplish underneath. It has the general appearance of a Dieffenbachia but never attains its large size. It requires moderate shade. Another outstanding member is *C. ornata.* Some of the dwarf Marantas fold up their leaves at night and have become to be known as Prayer Plants. The most colorful in the trade is the striking *Maranta Kerchoviana* with small cordate greenish leaves made attractive by the row of purplish blotches on each side of the midrib. Chlorophytums can be used with success as ground covers or in hanging-baskets. There are several nice forms with variegated foliage. Peperomias have been proven to be ideal dwarf foliage plants if not kept wet. Many of them bear thick, glossy, waxy leaves.

African Violets do well in a north window of Mrs. Ralph Landon's home.

It is impossible to describe all of the attractive exotic foliage plants in the trade, but perhaps a list of a few not already dealt with will be welcome:

PLANTS FOR QUITE SHADY SITUATIONS

Acalypha hispida
Alsophila australis
Ardisia crenulata
Bamburanta Arnoldiana
Cestrum nocturnum
Cissus antartica
Cissus rhombifolia
Coffea arabica
Clerodendron fallax
Clerodendron Thompsonae
Crinum asiaticum
Dieffenbachia spp.
Dracaena Sanderiana
Epiphyllum hybrids
Episcea cupreata
Eucharis grandiflora
Fatshedera Lizei
Hoffmannia Ghiesbreghti
Ixora coccinea
Ixora parviflora
Jacobinia magnifica
Jasminum Sambac
Marica gracilis
Marica Northiana
Phlebodium aureum

PLANTS FOR WELL-LIGHTED SITUATIONS

Alpinia formosana
Alpinia nutans
Aucuba japonica variegata
Bougainvillea spp.
Coccolobis floridana
Coccolobis uvifera
Cocos Weddelliana
Coleus spp.
Euphorbia splendens
Hibiscus Cooperi
Hibiscus hybrids
Hoya carnosa variegata
Kalanchoe Fedtschenkoi
Kalanchoe flammea
Kalanchoe Blossfeldiana
Kleinia fulgens
Moraea iridioides
Murraya exotica
Musa Cavendishiana
Myrsine africana
Ochna multiflora
Pandanus Baptistii
Pandanus Veitchii
Pedilanthus tithymaloides variegatus
Pereskia corrugata

Pilea microphylla
Polyscias Balfouriana
Polyscias filicifolia
Polyscias Guilfoylei
Rhaphidophora decursiva
Rhoeo discolor
Saintpaulia ionantha
Sanchezia nobilis
Setaria palmiifolia
Stenotaphrum secundatum variegatum
Strobilanthes isophyllus
Zebrina pendula
Pereskia sacharosa
Phoenix Roebelinii
Plumeria acutifolia
Portulacaria afra
Plumbago capensis
Rhapis excelsa
Strelitzia augusta
Strelitzia Reginae
Thevetia peruviana
Yucca aloifolia variegata
Yucca gloriosa
Yucca valida

NOTES

A group of students in botany from Southern Illinois University, Carbondale, accompanied by Dr. Margaret Kaeiser, professor of botany, visited the Garden library and herbarium recently.

The fourth number of Volume XXXVIII of the ANNALS OF THE MISSOURI BOTANICAL GARDEN has recently been issued, containing Fred G. Meyer's doctor's thesis, "Valeriana in North America and the West Indies (Valerianaceae)".

Recent visitors to the Garden include: Dr. E. R. Spencer, soil consultant, Lebanon, Ill.; Dr. Earl E. Berkley, of Anderson-Clayton Cotton Co., Houston, Texas, and Dr. William L. Brown, of Pioneer Hi-Bred Corn Co., Johnston, Iowa, both of whom received their doctor's degrees from the Shaw School of Botany; Dr. Charles B. Heiser, of Indiana University, Bloomington; Dr. A. E. Murneek, of University of Missouri, Columbia; Dr. Sven Grèn, Director Experimentalfältet, Stockholm, Sweden; Dr. and Mrs. Axel Mygren, of the Agricultural College, Upsala, Sweden; Dr. Erasmo Marré, Istituto Botanico Universita di Genova, Genoa, Italy; Dr. R. A. Evers, of the Illinois Natural History Survey, Urbana; Dr. M. Trufant Hall, of Cranbrook Institute of Science, Bloomfield Hills, Mich.; Dr. George A. Zentmeyer, of California Citrus Experiment Station, Riverside.

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SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 50,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah bus line (No. 42). The Southampton buses (No. 80), direct from downtown, pass within three blocks of the main entrance.

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